PHYSICAL APPLICATION CONSIDERATIONS

The versatility of air springs in vehicular suspensions leads the designer to new and different approaches in his designs. Tips on what is known to work best with regard to the air springs are discussed herein. Some of the conditions which are known to adversely affect the life of air springs are also presented.

The basic concept in all the desirable mounting geometries is to minimize the peak cord or bond stresses. Also, pinching and rubbing reduces air spring life and must be avoided.

1. DESIRABLE AIR SPRING MOUNTING GEOMETRIES

Suspension basic style and geometry are not considered here.

A. Rolling Lobe Air Springs

Figs. 5.1 and 5.2 show that the piston in a fully compressed position has the same centerline as the upper retainer. These figures show an ideal situation which allows ample internal clearance and full bumper contact.

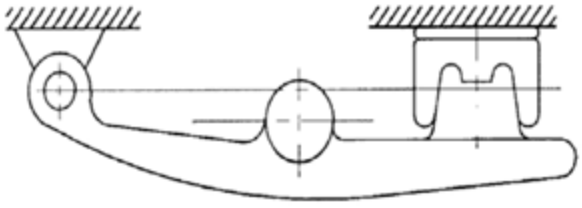

Fig. 5.1 Rolling Lobe fully compressed

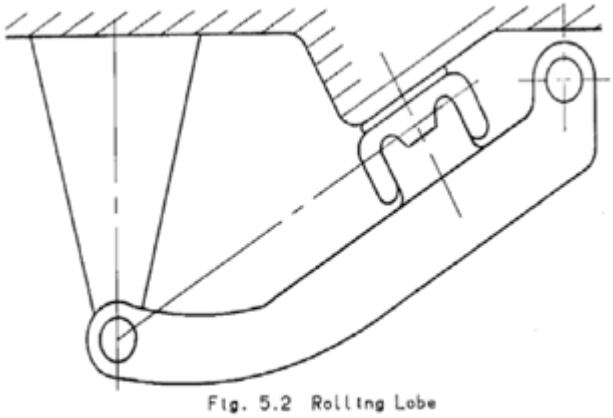

Fig. 5.2 Rolling Lobe
relationship between pivot and spring

However, Fig. 5.3 shows the range of positions in a more realistic situation. Because the air spring travels in an arcute path, the piston and upper retainer may not have the same center line at either design height or at compressed height. Also, the maximum horizontal displacement away from the pivot arm should be less than the maximum displacement toward the pivot arm.

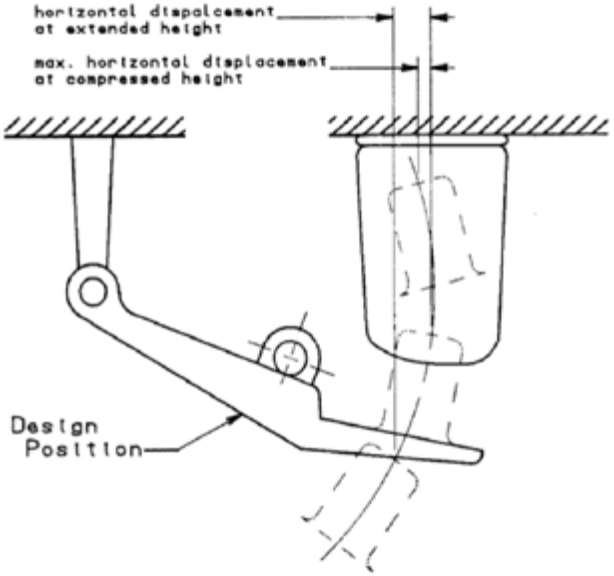

Fig. 5.3 Rolling lobe full travel

B. Bellows Type Air Springs

For maximum compression stroke, the end retainers should be parallel in the fully compressed position, as shown in Fig. 5.4. Be sure that a line drawn through the pivot point and perpendicular to the air spring assembly centerline also divides the air spring in half.

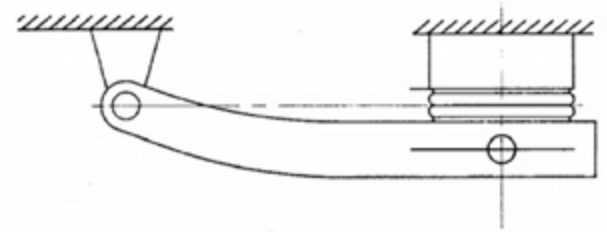

Fig. 5.4 Suspension arm with bellows air spring

The end retainers may be parallel at the design height if adequate compression stroke can be obtained. But the previous statement always applies.

The centerline of the lower retainer and the upper retainer should coincide in the fully compressed position.

C. Parallelogram Suspension Linkage

The centerline of the piston should move equal distances fore and aft of the upper retainer centerline when the piston is moved through its full travel. The normal design position is shown in Fig. 5.5.

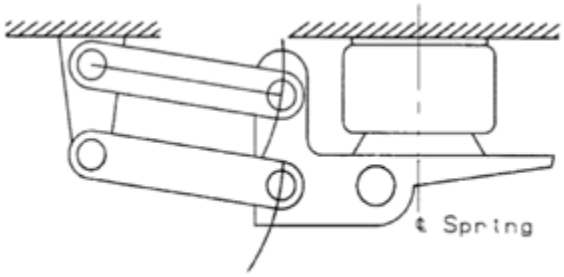

Fig. 5.5 Parallelogram suspension linkage

D. Multi-Axle Pneumatic System

With a multi-axis arrangement, it is possible to connect all the springs on each side of the vehicle or trailer to a common air supply after it has been through the height control valve (see Fig. 5.6). It is best to have the maximum size tubing practical for the application connecting all springs in such a system. The advantages are that as an individual spring flexes, all the other springs act as reservoirs, thus reducing the pressure change and the dynamic spring rate of that spring. The somewhat increased pressure in the other springs has only a mild effect on their spring rate and the shock to the vehicle is damped, reduced, and distributed over a greater area. This arrangement does not affect vehicle roll stability.

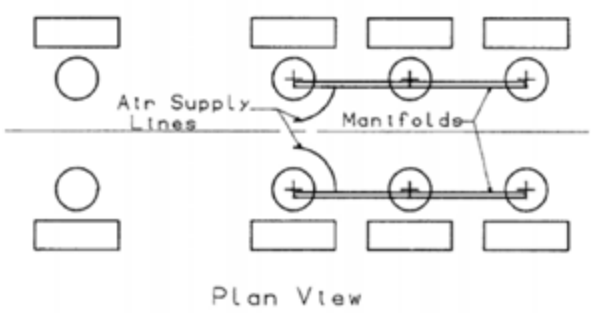

Fig. 5.6 Multi-axle pneumatic system

2. UNDESIRABLE AIR SPRING MOUNTING GEOMETRIES

The examples mentioned in this section are extreme cases.

Pneumatic springs are capable of long operation with much abuse, but poor operating geometries will result in earlier failures than springs used with good geometries. Rather small changes in operating geometries on long stroke life tests can show 4-10 times life improvement with improved geometries. Field operations will probably not show as dramatic life improvements because of fewer long strokes in service, but certainly the trend toward improvement will be there.

Avoid centerline offset as is illustrated in Fig. 5.7. The rolling lobe type is less sensitive to misalignment than the bellows.

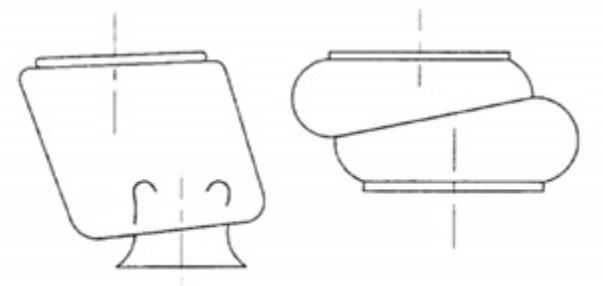

Fig. 5.7 Air springs mounted with offset centerlines (avoid if possible)

Fig. 5.8 shows piston centerlines improperly related to the pivot arm. There will be increased wear at the upper mounting plate and on the sleeve where it rolls on the piston, plus the possibility of internal rubbing.

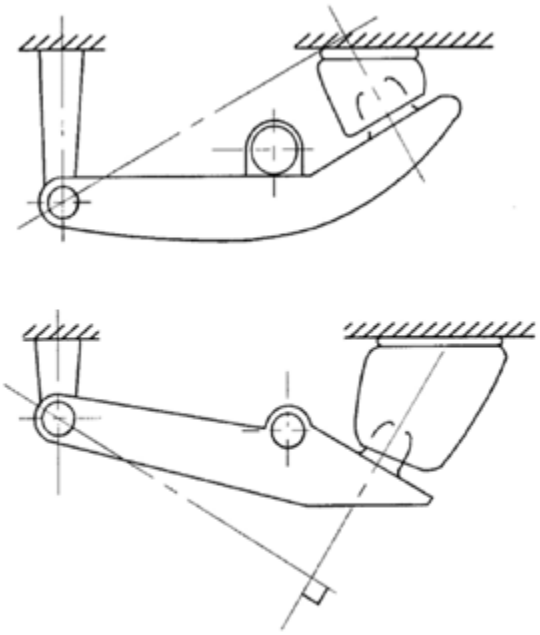

Fig. 5.8 Incorrect piston mounting angle

The lower mounting designs shown in Fig. 5.9 are unstable and unnecessary if other proper design criteria are employed.

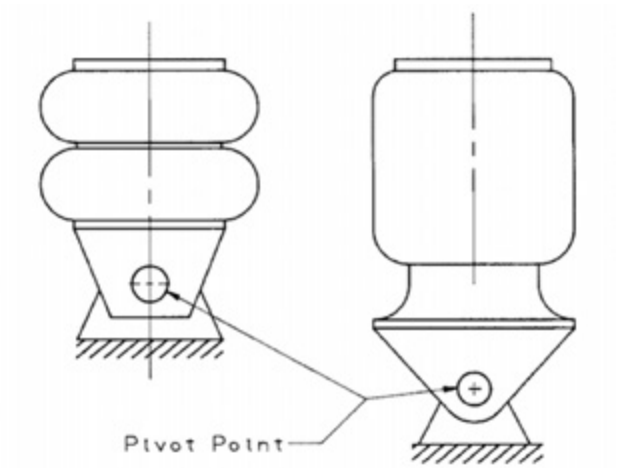

Fig. 5.9 Unstable mounting

Fig. 5.10 shows an air spring under low pressure conditions which may cause it to buckle and fold when compressed and may be damaged in the fully compressed positions. It will wear internally, causing reduced life.

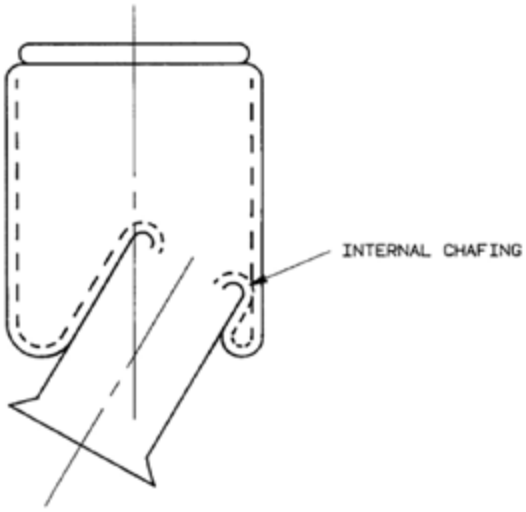

Fig. 5.10 Low pressure and internal chafing