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NASA TECH BRIEF

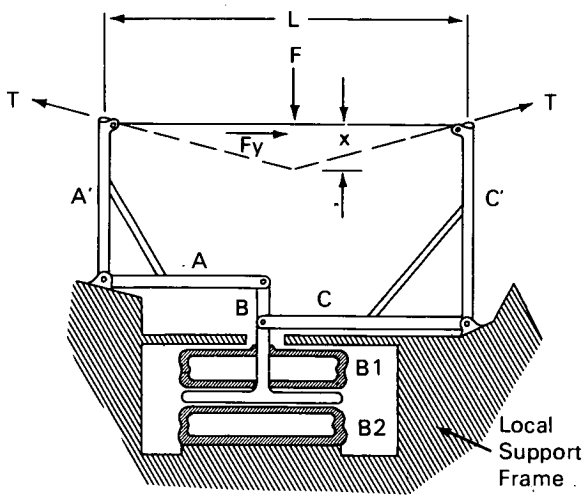
Adjustable Support Spring

A restraining spring mechanism acting against force F as shown in the figure was designed and developed. It was required that the spring constant,

$$K = \frac{\text{spring force}}{\text{spring displacement}},$$

be adjustable over a range and that performance not be affected by changes in ambient pressure.

A cable loaded at the center with a force F will deflect an amount x, depending on its length L and tension T. Two air bellows B1 and B2 provide a nearly



constant tension on the cable. The bellows can exert a large force, but one that changes little with displacement due to their soft spring constant. By variation of the pressure difference between bellows B1 and B2, the cable tension and hence the system spring constant K can be varied.

Because two bellows are used, the net bellows force, and hence T and K, are not influenced by ambient pressure. Thus, spring rate (F/x) will not change with ambient pressure. The natural frequency of the device is varied by changing the absolute pressures within the air bellows and thus may be tuned to prevent coupling, while still maintaining a given spring constant K.

The members A, B, and C in the figure form a "Watts Linkage" which imparts high lateral stiffness to the system (i.e., the bellows' soft spring constant does not appear in the "Y" direction until the force Fy exceeds the cable's initial tension T). Small lateral motions of member B are accommodated by the yielding of bellows B1 and B2. The design requires that the ratio A/A is equal to the ratio C/C'.

All working forces, which may be several times F, are reacted within the local support frame. Therefore, a structure supporting the frame does not have to be larger than needed to withstand F.

Note:

No additional documentation is available. Specific questions, however, may be directed to:

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Reference: B70-10636

Patent status:

No patent action is contemplated by NASA.

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Category 07