(b) Link masses lying off the joint-to-joint axes may be employed without restriction.

c) Since the coefficients of all time-dependent terms are made zero permanently, any restrictions on mobility or other purely kinematic limitations on a given linkage do not invalidate the method.

d) As the examples have shown, the resulting weight increases, as well as the physical dimensions of the counterweights, can easily conform to the demands of practical applications.

References


Discussion

Joseph Ku

This paper presents a mathematical procedure whereby the total center of mass of a constrained four or six-bar planar linkage is made independent of the position of the input and hence time invariant. The presentation is clear, concise and in logical sequence.

However, several interesting observations could have been included in this paper as regarding the effects of using this method to balance a linkage. Firstly, although this method ensures that the vector sum of the forces acting on the mechanism frame vanish at all times, the individual force components in the horizontal and vertical directions are nevertheless finite and time varying. Hence, each of the linkage supports at the frame is individually still being subjected to a cyclic shaking force. The magnitude of these forces may actually be greater than the magnitude before balancing, due to the equal but opposite vertical force components acting at the linkage supports. Again, this shaking moment may actually be greater than that of the "unbalanced" case.

Author's Closure

The authors appreciate Mr. Ku's remarks and agree with them completely. The discussion of these questions has been purposely omitted in this paper because of the extended design considerations that have been found to be associated with them. We are pleased to report that a paper concerned with these problems will shortly be submitted to the American Society of Mechanical Engineers.