CLAIMS

1. A pneumatic actuator for imparting velocity to a resting object, comprising a fixed member and a ram, the ram having two or more generally elongated ram members, each having a first end and a second end,

wherein the fixed member is formed with a base plate, an inner cylinder, and an outer cylinder, said inner cylinder and said outer cylinder being fixedly joined to the base plate concentrically about a center axis, the base plate having an inlet hole therethrough, said inlet hole being in fluid communication solely with space inside said inner cylinder,

wherein the ram members are disposed concentrically about said center axis so as to lie one within another and within the outer cylinder, the first end of each ram member being disposed closer to the base plate than its second end, and to move parallel to the center axis in a telescopic arrangement,

wherein the innermost one of said ram members is accommodated within said inner cylinder, has at its first end a seal in sliding contact with said inner cylinder so as to prevent gas flow therebetween, and is configured so that pressurized gas fed through said inlet hole initially acts only on said innermost ram member to displace said innermost ram member independently of the other ram members along said inner cylinder and so that its second end drives the object, and

wherein each of the other ram members is disposed externally to said inner cylinder so as to be acted on by the pressurized gas only after displacement of said innermost ram member along said inner cylinder so as to begin to move only after said innermost ram member is extended, said seal being configured to clear said inner cylinder upon displacement of said innermost ram member therealong, thereby permitting the pressurized gas to flow out of said inner cylinder and act on at least one of said other ram members;

the actuator being operative, upon the feeding of pressurized gas into the inlet hole, to move said innermost ram member along its entire range of motion and thereby impart velocity to the object.

2. The actuator of claim 1, wherein said innermost ram member includes at its first end a flange carrying said seal.

3. The actuator of claim 1, configured so that none of said other ram members exerts a force, directly or indirectly, on said innermost ram member in a direction away from the base plate at any time during operation.

4. The actuator of claim 3, being further operative to have any of the ram member pull another ram member that is disposed next outside it.

5. The actuator of claim 3, further comprising a shock absorbing system, in fluid communication with a space between said outer cylinder of the fixed member and the outermost one of said ram members, the shock absorbing system comprising a constriction disposed in a liquid flow path from said space, the constriction being configured such that its resistance to flow increases with the speed of said outermost ram member, and the shock absorbing system being operative to prevent said outermost ram member from moving faster than the ram member next within it.

6. The actuator of claim 1, wherein at least two of the ram members include means for locking one of them to the other.

7. The actuator of claim 1, further comprising means for interlocking any one of the ram members with a second ram member next outside it.

8. The actuator of claim 7, wherein said means for interlocking are operative to interlock said one ram member with said second ram member upon said one ram member having moved a predefined distance relative to said second ram member.

9. The actuator of claim 8, wherein said means for interlocking include a pin near the first end of said one ram member and a groove near the second end of said second ram member, the groove formed to accommodate said pin.

10. The actuator of claim 7, configured so as to enable each of said other ram members to be driven by the pressurized gas while that ram member is interlocked with a ram member next within it.

11. The actuator of claim 10, wherein the effective cross-sectional area of all the ram members that are interlocked and over which the gas exerts a pressure to effect said driving, at any time during operation, is inversely related to approximately the average gas pressure expected at that time.

12. A system for imparting velocity to a resting object, comprising one or more actuators as in claim 1, a reservoir, containing pressurized gas, and an activation valve corresponding to each of the actuators, wherein said reservoir is in fluid communication, through said activation valves, with the inlet holes in the corresponding actuators, the system being operative to allow the pressurized gas to be fed into any of said inlet holes when the corresponding activation valve is open.

13. The system of claim 12, wherein any of said actuators further comprises means for interlocking any one of the ram members with a second ram member next outside it.

14. The system of claim 13, wherein said any of said actuators is configured so as to enable each of said other ram members to be driven by the pressurized gas while that ram member is interlocked with a ram member next within it.

15. The system of claim 14, wherein, for any of said actuators, the effective cross-sectional area of all the ram members that are interlocked and over which the gas exerts a pressure to effect said driving, at any time during operation, is inversely related to approximately the average gas pressure expected at that time.

16. A pneumatic actuator for imparting velocity to a resting object, comprising a fixed member and a ram, the ram having two or more generally elongated ram members, each having a first end and a second end, wherein the fixed member is formed with a base plate, an inner cylinder, and an outer cylinder, said inner cylinder and said outer cylinder being fixedly joined to the base plate concentrically about a center axis, the base plate having an inlet hole therethrough, said inlet hole being in fluid communication solely with space inside said inner cylinder, wherein the ram members are formed and disposed concentrically about said center axis so as to lie one within another and within the outer cylinder, the first end of each ram member being disposed closer to the base plate than its second end, and to move parallel to the center axis in a telescopic arrangement, wherein the innermost one of said ram members is accommodated within said inner cylinder, has at its first end a seal in sliding contact with said inner cylinder so as to prevent gas flow therebetween, and is configured so that pressurized gas fed through said inlet hole initially acts only on said innermost ram member to displace said innermost ram member independently of the other ram members along said inner cylinder and so that its second end drives the object, and wherein each of the other ram members is further formed and configured so as to move only behind said innermost ram member, is disposed externally to said inner cylinder so as to be acted on by the pressurized gas only after displacement of said innermost ram member along said inner cylinder so as to begin to move only after said innermost ram member is extended, said seal being configured to clear said inner cylinder upon displacement of said innermost ram member therealong, thereby permitting the pressurized gas to flow out of said inner cylinder and act on at least one of said other ram members; the actuator being operative, upon the feeding of pressurized gas into the inlet hole, to move said innermost ram member along its entire range of motion and thereby impart velocity to the object,

and wherein said ram members are configured so that none of said other ram members exerts a force, directly or indirectly, on said innermost ram member in a direction away from the base plate at any time during operation, and wherein the pneumatic actuator further comprises a shock absorbing system, in fluid communication with a space between said outer cylinder of the fixed member and the outermost one of said ram members, the shock absorbing system comprising an adjustable constriction disposed in a liquid flow path from said space, the adjustable constriction being configured such that its resistance to flow increases with the speed of said outermost ram member, and the shock absorbing system being operative to prevent said outermost ram member from moving faster than the ram member next within it.

17. The actuator of claim 5, wherein said constriction is adjustable.