Jan. 11, 1966 R. L. KOSSAN ET AL 3,228,192

BUFFER MECHANISM FOR ADAPTER RAIL

Original Filed March 26, 1963 4 Sheets-Sheet 1

FIG. 1

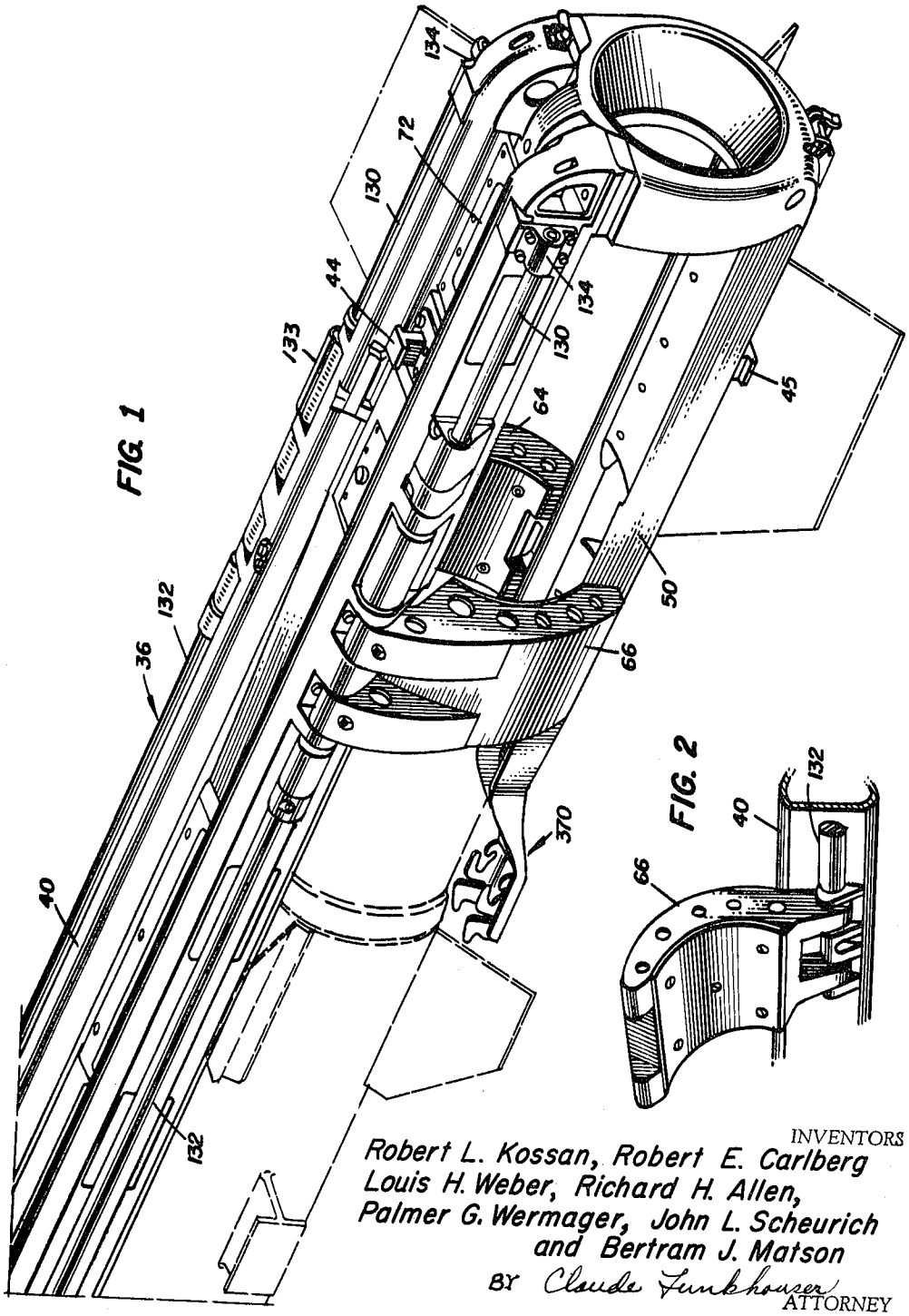


FIG. 2

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Jan. 11, 1966 R. L. KOSSAN ET AL 3,228,192

BUFFER MECHANISM FOR ADAPTER RAIL

Original Filed March 26, 1963 4 Sheets-Sheet 2

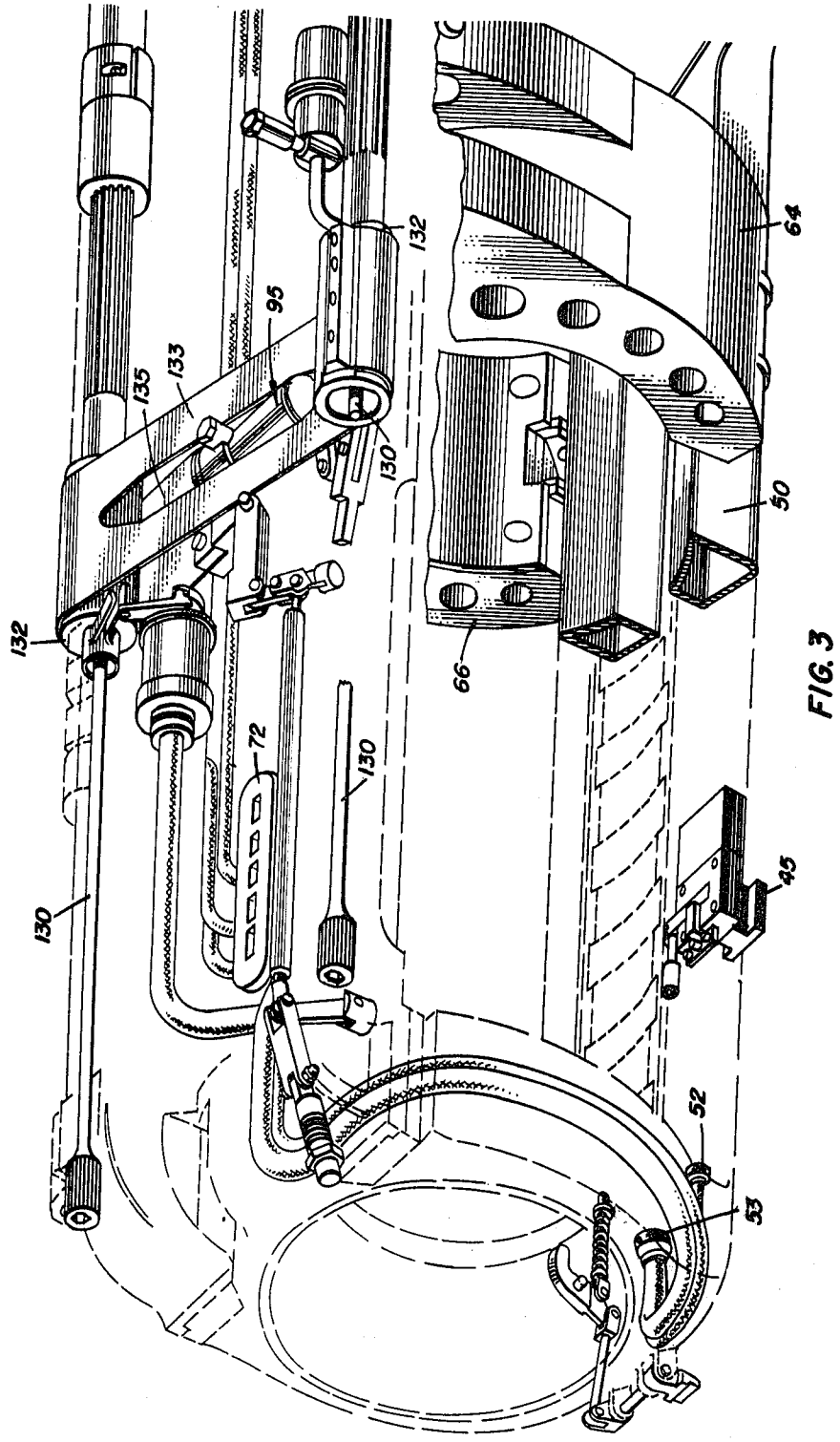


FIG. 3

Jan. 11, 1966 R. L. KOSSAN ET AL 3,228,192

BUFFER MECHANISM FOR ADAPTER RAIL

Original Filed March 26, 1963 4 Sheets-Sheet 3

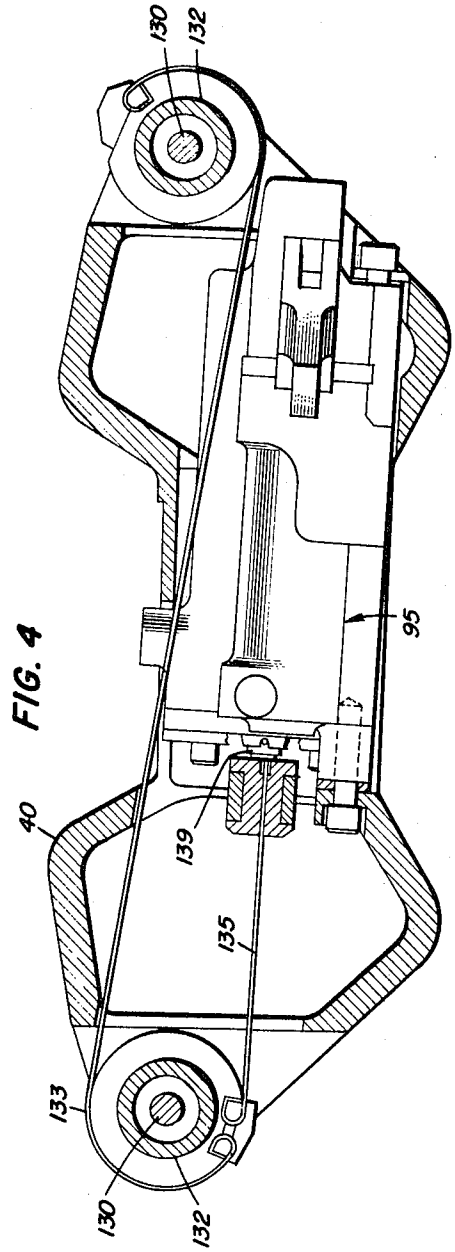


FIG. 4

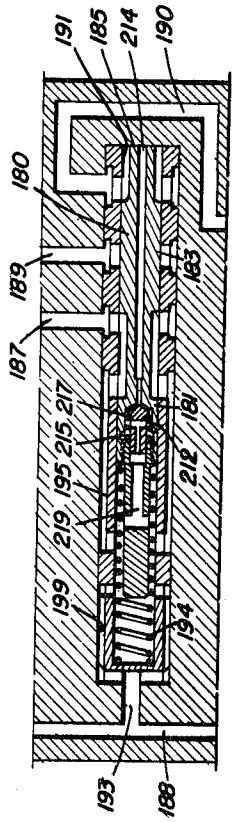
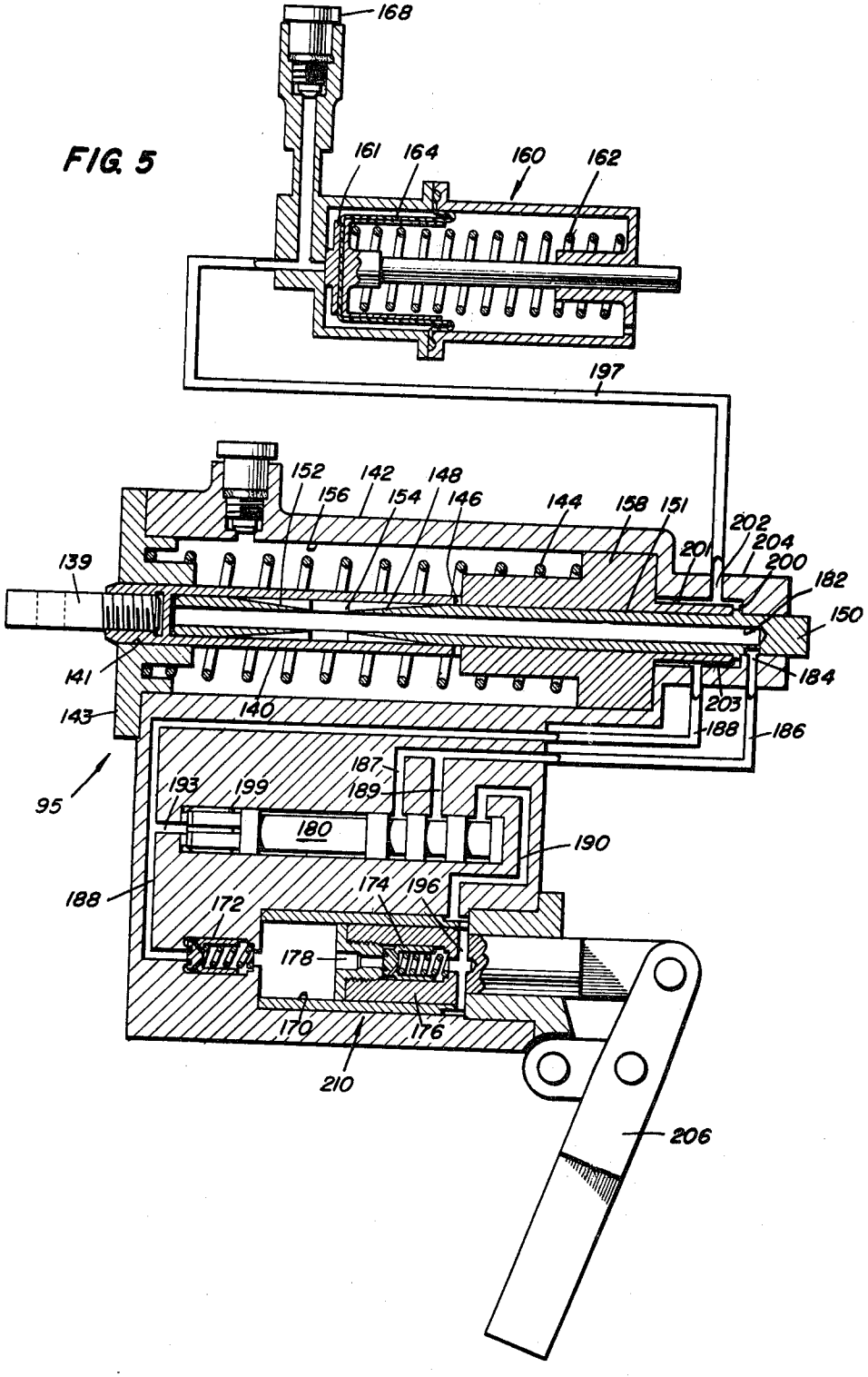


FIG. 6

BUFFER MECHANISM FOR ADAPTER RAIL

Original Filed March 26, 1963 4 Sheets-Sheet 4

FIG. 5



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BUFFER MECHANISM FOR ADAPTER RAIL

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Original application Mar. 26, 1963, Ser. No. 268,496. Divided and this application May 26, 1964, Ser. No. 385,533

1 Claim. (Cl. 60—51)

This application is a division of copending U.S. application Serial No. 268,496, filed March 26, 1963, by the present applicants.

This invention relates to missile launchers and more particularly to a buffer system, acting as an energy absorber for use in such launchers.

Heretofore, in the field of missile launchers, it has generally been found necessary to develop a different launching system for each different size or type of missile according to the particular needs of each missile. Variation in size of missiles has been a particularly perplexing problem because it requires not only the development of a new system but also the redesign of each individual component within the system. That is to say, when a new type of missile is developed, a launching system can be designed and constructed by using the existing components of another launching system for a different missile which is of the same or similar configuration and size. However, when a missile is developed which is not only of a different type but also of a different size and configuration, the existing components, e.g., magazine and launcher, cannot be used. Thus, it becomes necessary to develop a new system with new components for this last-mentioned missile.

In addition to the difference in physical requirements, the newly designed missile may have other characteristics that are different from those of the original missile. For example, the new missile may require a longer length of travel before it can sustain stable free flight. That is, the rails on the launcher arm may provide a given length of guided travel which was adequate to permit the original missile to sustain stable free flight, but that length of guided travel would not be sufficient to allow the new missile to attain free flight in a stable manner. Since the launcher arm does not have adequately long rails, it could not be used for the new missile even if the physical configuration of the new missile were identical with the original missile, i.e. the missile for which the system, and thus the launcher arm, was designed.

It is, therefore, an object of the present invention to provide a means for adapting a missile of a given size and type for use in a launching system which was intended for launching a missile of a different type and size.

Another object of the present invention is to provide a buffer assembly in the form of a cylinder and piston which will act as an energy absorber in a missile launching system.

It is still another object of the present invention to provide a buffer assembly having a spring biased piston operating in a cylinder, and to provide valve means for controlling the action of the piston so that the movement of the piston will act as an energy absorber in a missile launching system.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following

detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a diametric view of the rear portion of the adapter rail with a secured missile;

FIG. 2 is a diametric view of the aft snubber in its open position;

FIG. 3 is a diametric view of a mechanical schematic of the rear portion of the adapter rail;

FIG. 4 is a cross section view taken through the rear portion of the rail and showing the buffer system;

FIG. 5 is a hydraulic schematic of the buffer system;

FIG. 6 is a detailed schematic of the pressure relief valve in the buffer system.

Referring now to the details of the drawings, the figures show a buffer assembly connected in a missile launching system which by virtue of the present invention is capable of handling and launching three different types of missiles, missile A, missile B, and missile C, which are shown on the ready service ring in FIG. 2. The missile launching system has a magazine room having a pair of ready service rings therein for storing missiles. The ready service rings are capable of being rotated to bring the desired missile into a position where it can be hoisted onto a feeder mechanism for transporting the missile onto the launcher arm of a missile launcher. The missiles are held in individual trays on the ready service ring. The missile launching system was designed and constructed to accommodate a given missile A, and through the use of inserts in the trays on the ready service ring, the system can handle a missile B, which is slightly smaller but has the same lug configuration. A much smaller missile, such as missile C, could not be successfully fired from this system. However, by using the adapter rail it is possible to utilize a system designed for one missile in the launching of an entirely different missile.

The missile C is retained on the adapter rail by means of forward and aft snubbers **60** and **62** respectively, which are mounted on the beam **40**. The snubbers **60** and **62** are mounted on off-center bearings so that as they close they do not contact the missile until uniform pressure is applied to the whole area of contact.

A pair of torsion bars **130** shown in FIG. 1 are anchored at one end by means of clamps **134** bolted to the aft end of the beam **40** and extended through torque tubes **132** to the forward snubber **60** where the bars are attached, one bar being secured to each of the arms. With the snubbers open, the torsion bars are preloaded to a torque of approximately 55 foot pounds each. The torsion bars **130** have opposite torques preset in them, i.e. the right hand bar has a clockwise and the left hand bar has a counterclockwise torque as viewed from the rear, so that when unlatched the bars will rotate in a counterclockwise and clockwise direction, respectively. The torque tubes **132** are attached to the torsion bars at their forward ends and at their aft ends are attached to the arms **64** and **66** of the aft snubber **62**. When the forward snubber is unlatched by action of the arming socket, the torsion bars rotate and open the forward snubber. The torque tubes are also rotated by the action of the torsion bars and open the aft snubber **62**. FIG. 2 illustrates the right arm of the aft snubber in open position.

At a point near the aft end, the torque tubes **132** are connected by a steel band **133** which is wound over the top of the left hand torque tubes and attached thereto and under the bottom of the right hand torque tube and attached thereto. A second steel band **135** is attached at one end to the left hand torque tube. The other end of the second band is pinned to an extension arm **139** connected to a buffer **95**.

The buffer 95, shown in detail in FIG. 5 comprises a cylinder 142 having a bore 156 therein. A buffer piston 158 having a reduced section or arm 140 is movable in bore 156. An end cap 143 having a central bore 141 seals off end of cylinder 142 and retains the piston 158 therein. Arm 140 extends through and is slidable in bore 141. A compression spring 144 is interposed between cap 143 and the piston 158 and urges the same away from the cap 143. Piston 158 and its arm 140 have a bore 151 extending from the end opposite cap 143 substantially but not completely therethrough. An orifice 146 in arm 140 adjacent to the junction of arm 140 and piston 158 connects bore 151 in arm 140 with the bore 156 in cylinder 142. A rod 150 is rigidly attached to and seals off the end of cylinder 142 opposite cap 143. A bore 182 extends substantially but not completely through rod 150 from the end adjacent to the cap 143. The outer surface of rod has control grooves 148 and 152 cut therein. Groove 148 starts at a point adjacent to orifice 146, when the buffer piston 158 is at the limit of its travel away from cap 143, and increases in depth until it merges with the edge of opening 154 which communicates with bore 182 in rod 150. Control groove 152 starts at maximum depth at the edge of opening 154 and decreases in depth until it merges with the outside surface of rod 150. These control grooves 148, 152, and opening 154 determine the acceleration, constant velocity, and deceleration of the snubber arms, as will be explained hereinafter.

Bore 182 in rod 150 is connected by means of orifice 184 to conduit 186 which communicates with a pressure cut-off valve 180 shown in FIG. 6 through conduits 187 and 189. Valve has a valve piston 185 having two lands 181 and 183 movable within a cylinder 191. A compression spring 194 is interposed between the piston 185 and one end of cylinder 191 and urges the piston 185 toward the other end of said cylinder. When the piston 185 is urged to its limit of travel toward the right, as shown in FIG. 6, the space between lands 181 and 183 provides a connection between conduit 187 and by-pass conduit 195 in cylinder 191. By-pass conduit 195 is always in free-flow communication with conduit 188 by means of conduit 193 and a second by-pass conduit 199 also in cylinder 191. Conduit 188 is connected to an accumulator 160 by means of a clearance 200, between a protrusion 202 on piston 158 and a reduced extension 204 on cylinder 142, a second clearance 201 between the protrusion 202 and the bore 203 in extension 204, and conduit 197. The accumulator is of the piston-type and is spring-loaded by means of compression spring 162. To prevent the compressible gas, e.g., air, behind the piston 161 from mixing with the hydraulic fluid in front of it, a flexible diaphragm 164 of gas impervious material, e.g., rubber, extends over the piston face and is attached to the cylinder wall. The diaphragm 164 moves with the piston 161. Hydraulic fluid is replaced in the accumulator through an oil fill inlet 168 mounted on the top thereof.

When the forward snubber is unlatched by the action of the arming socket, as previously described, the torsion bars 130 rotate the arms 68 and 69 of the forward snubber 60 upward. The rotation of the torsion bars 130 causes the torque tubes 132 to rotate and open the aft snubber 62. As the torque tubes rotate, steel band 135 exerts a force on extension arm 139 which causes buffer piston 158 to move toward cap 143 against the bias of spring 144. As buffer piston 158 moves to the left, as shown in FIG. 5, hydraulic fluid contained in bore 156 will be forced through orifice 146 and through control groove 148. Orifice 146 will move with the buffer piston 158 toward the left and will consequently be in direct communication with a progressively deeper portion of groove 148. As the depth of groove 148 increases, the resistance to flow of the hydraulic fluid decreases and the buffer piston will accelerate. As the orifice 146 passes over opening 154, the resistance to flow of hydraulic fluid will remain constant and the velocity of buffer piston 158 will be constant also. Subsequent movement of the buffer piston will bring the orifice in direct communication with control groove 152 which decreases in depth toward the left. The resistance to flow of hydraulic fluid will, therefore, increase and the buffer piston 158 will decelerate. Thus, it will be apparent that the movement of the snubber arms is controlled through a cycle of acceleration, constant velocity, and deceleration because of the controlled movement of the buffer piston 158.

As will be apparent by referring to FIG. 5, the movement of the buffer piston 158 will cause the hydraulic fluid to pass to the accumulator 160 by flowing through orifice 146, control grooves 148 or 152 and opening 154 to bore 182 in rod 150, through orifice 184 to conduit 186, through conduit 186 to conduit 187, between the lands 181 and 183 on valve piston 185 to by-pass conduit 195 and 199 to conduit 193, from there to conduit 188, through clearances 201 and 200 and through conduit 197.

Once the snubbers 60 and 62 are opened, the buffer piston 158 is moved to the left, as viewed in FIG. 5 and the pump 210 is utilized to return the buffer piston 158 to the right and to close the snubbers. Pump 210 is composed of a handle 206 pivotally mounted in such a manner as to move pump piston 176 within cylinder 170. Pump piston 176 has an axial bore 178 extending from one face to and connecting with a transverse bore 196. A spring-loaded check valve 174 is disposed within bore 178 and permits flow of hydraulic fluid only to the right, as viewed in FIG. 5.

Conduit 188 is connected to the back end of cylinder 170 and has a spring-loaded check valve 172 positioned therein and ajacent said cylinder which permits flow into cylinder 170 only or to the right as viewed in FIG. 5. When the pump piston 176 is moved to the left, as viewed in FIG. 5, check valve 172 remains closed, and check valve 174 opens allowing fluid to pass through bores 178 and 196 and into the front portion of cylinder 170. Then as the pump piston is moved to the right check valve 172 opens allowing fluid to pass into the back of cylinder 170 and check valve 174 remains closed forcing fluid through conduit 190. Thus, it will be seen that as the pump piston 176 is moved back and forth by movement of handle 206 fluid is pumped from the accumulator 160 through the conduit 197, around the clearances 201 and 200, through conduit 188, and through conduit 190 to pressure cut-off valve 180. Conduit 190 is connected to cylinder 191 at a point ahead of the first land 183 when the valve piston 185 is at its limit of travel to the right. The hydraulic fluid entering ahead of land 183 will shift the valve piston 185 to the left, as viewed in FIG. 6, against the bias of spring 194. When the valve piston 185 shifts to the left, the clearance ahead of the first land 183 will provide communication between conduit 190 and conduit 189. Thus, fluid will be pumped from the accumulator through the conduits, as previously explained, to conduit 186, through orifice 184, through bore 182, through the opening 154, and orifice 146 to the bore 156 in cylinder 142. The increase of fluid pressure in bore 156 will move the buffer piston to the right against the force to the steel band 135 and the torque of the torsion bars 130 on the torque tubes 132. Thus, the arms of the snubbers will be rotated to a closed position. Valve piston 185 has an axial bore 214 with a spring-loaded, pressure relief valve 212 disposed therein. Valve 212 will open when the piston 158 has returned to the right and subsequent pumping increases the pressure beyond the force of the spring in said valve. When valve 212 opens the hydraulic fluid will be routed through bore 214, around valve 212, through internal recess 215 in piston 185, through T-shaped conduit 217 in valve 212 to T-shaped conduit 219 in piston 185 and from there back to the pump as will be obvious from FIGS. 22 and 23.

Obviously many modifications and variations of the present invention are possible in the light of the above

teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

A buffer system for controlling the rate of movement of an extension arm attached to a steel tape comprising:

a cylinder containing a fluid;

an accumulator connected to one end of the cylinder receiving and discharging fluid from and to said cylinder;

rod means attached to and extending into and along the longitudinal axis of said cylinder, said rod being formed with a central bore and tapered control grooves connected to said bore;

a piston formed of a smaller and a larger diameter section slidably mounted on said rod means and within said cylinder, the larger diameter section of the piston being in contact with the cylinder wall, the smaller diameter section being formed at its end with an annular interiorly threaded recess receiving the extension arm, said piston at the juncture of the smaller and larger sections being formed with orifices connecting the interior of the cylinder with the bore of the rod means;

a cap forming one end wall of said cylinder and serving as a bearing for the smaller section of the piston;

spring means biasing the piston in one direction;

pump means for exerting pressure on the fluid for moving the piston within the cylinder, movement of said piston being controlled by the flow of fluid through the orifices, the control grooves, and the bore of the rod means;

and a pressure valve means for isolating said pump means from said cylinder when said piston is moved to spring biased position.

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