Nov. 17, 1953 G. B. MARSDEN 2,659,207

DIFFERENTIAL CYLINDER WITH TOGGLE LOCK

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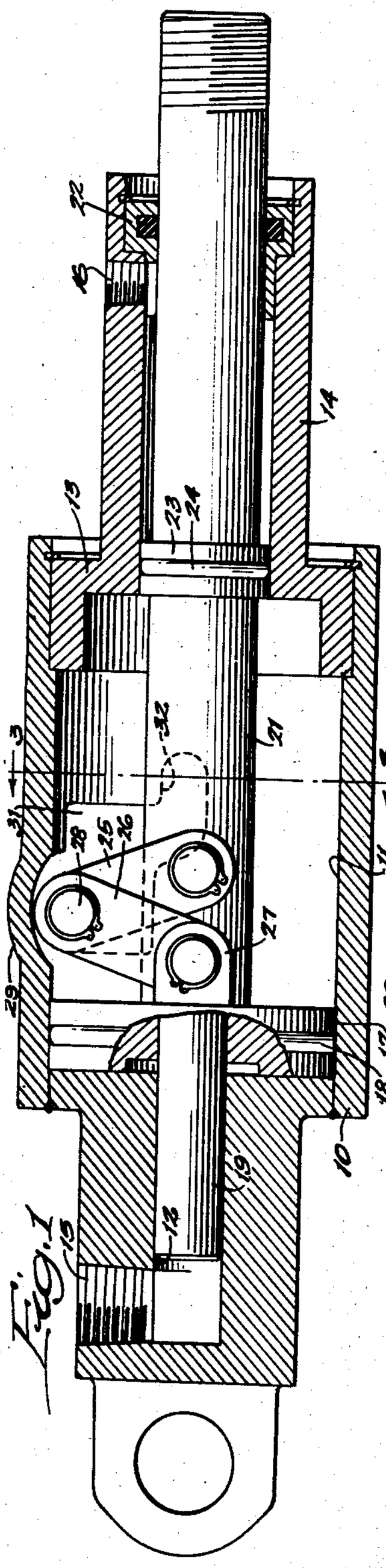

Fig. 1

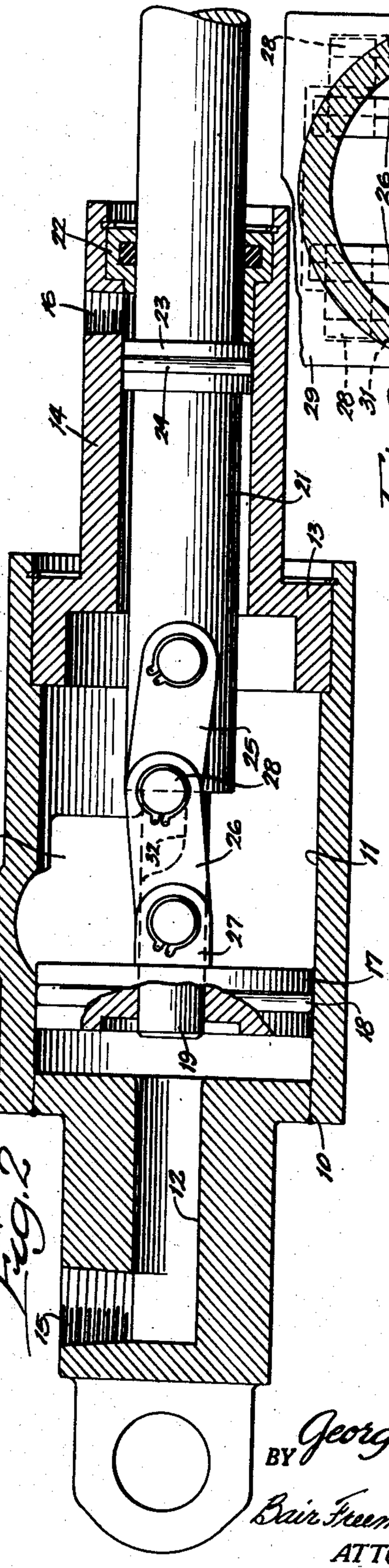

Fig. 2

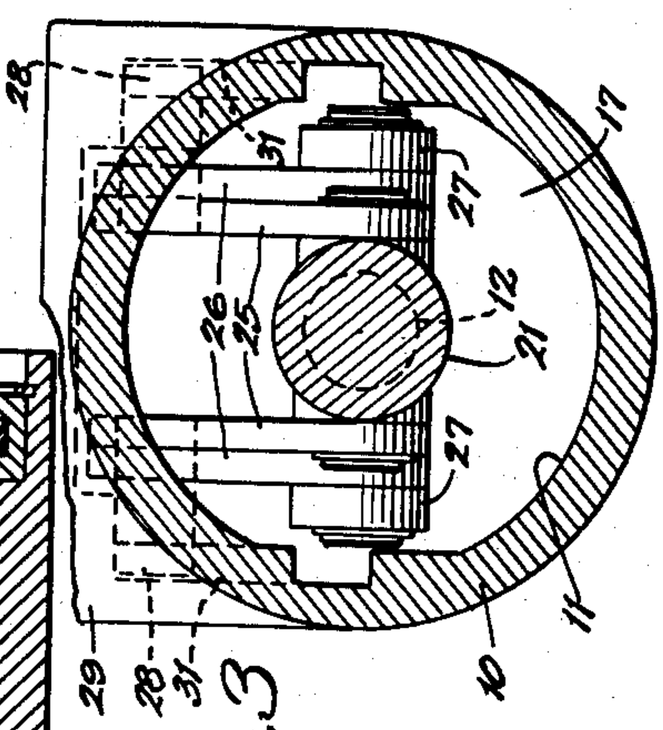

Fig. 3

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DIFFERENTIAL CYLINDER WITH TOGGLE LOCK

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8 Claims. (Cl. 60—97)

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This invention relates to a differential cylinder with a toggle lock and more particularly to a fluid operated cylinder and piston device employing a toggle linkage to connect the pistons during certain stages of operation.

Differential cylinder mechanisms have heretofore been proposed in which the operating fluid is first effective on a relatively small piston and thereafter on a larger piston which is releasably connected to the small piston. One such mechanism is more particularly disclosed and claimed in my copending application, Serial No. 337,157, filed February 16 1953. The present invention relates to a differential cylinder mechanism of this type and has for one of its objects the provision of a simple and effective mechanical locking means to connect the pistons.

Another object is to provide a differential cylinder in which the pistons are connected through a mechanical linkage which is extended by movement of the small piston relative to the large piston and which is locked in its extended position by initial movement of the large piston.

Still another object is to provide a differential cylinder in which the linkage is held extended by a stationary cam surface engaging a portion of the linkage after it is initially moved by the large piston.

A further object is to provide a differential cylinder in which the pistons are returned to their initial position by means acting solely on the small piston. In this construction the linkage connects the small and large pistons during the initial part of their return movement to effect return of the large piston.

According to one feature of the invention the return means is formed by an annular piston connected to the small piston and acted upon by operating fluid to return the pistons.

The above and other objects and features of the invention will be more readily apparent from the following description when read in connection with the accompanying drawing, in which

Figure 1 is a longitudinal central section with parts in elevation through a differential cylinder embodying the invention;

Figure 2 is a view similar to Figure 1 showing the parts in a moved position; and

Figure 3 is a transverse section on the line 3—3 of Figure 1.

The cylinder construction as shown comprises a body or housing 10 which may be in the form of an integral casting and which is formed with a first relatively large bore 11 and a second smaller bore 12 aligned with the bore 11. The end of the

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bore 11 is closed by an annular closure plate 13 formed with a tubular extension 14 thereon. Operating fluid may be supplied to the outer ends of the bore 12 and the extension 14 through connections 15 and 16.

A first relatively large piston 17 is slidably mounted in the large bore 11 and is sealed thereagainst by means such as an O ring 18. The piston 17 is formed with a central opening therein through which a smaller second piston 19 projects to fit slidably in the smaller bore 12. The second piston 19 is formed with an extension 21 projecting through the end of the extension 14 to be connected to a load. An annular sealing ring 22 fitted within the extension 14 seals against the extension 21 to prevent leakage of fluid therebetween.

The extension 21 is formed with an annular piston 23 which fits slidably in the tubular extension 14 and may be sealed therein by annular sealing means such as an O ring 24. The piston 23 effects the return stroke of cylinder.

The pistons 17 and 19 are connected by a toggle linkage including a first link 25 pivoted at one end to the extension 21 and a second link 26 pivoted at one end to ears 27 carried by the piston 17. At their opposite ends the toggle links are connected by pivot pins 28 which project outward therefrom to fit into cam tracks provided in the sides of the body.

As best seen in Figure 3, the body is enlarged throughout a portion thereof to form flat parallel surfaces at its sides in which the cam tracks may be cut. As shown, the toggle linkage is duplicated with similar single toggle links at each side of the extension 21 so that pins 28 extend outwardly from each side of the pistons. The enlarged part of the housing, as shown at 29, provides flat surfaces generally parallel to the planes of the single linkages which are cut out through a relatively large rectangular area 31 and through relatively narrow forwardly extending grooves 32 defining the cam tracks.

When the mechanism is in its initial position both of the pistons are moved to the left as shown in Figure 1, and the toggle linkages are collapsed so that the pivot pins 28 thereof lie in the upper lefthand portions of the cam tracks 31. When operating fluid is supplied through the connection 15, it will act on the exposed end of the small second piston 19 to move it to the right. At this time the piston 17 will remain stationary since the operating fluid does not act on it. This phase of operation continues until the small piston has moved out of the bore 12 to expose the large

piston to fluid pressure entering the connection 15. During this initial part of the movement the small piston and its extension 21 will be moved rapidly but with a relatively low degree of force to shift the load rapidly.

After the piston 19 has moved out of the bore 12, pressure will become effective on the large first piston 17 to shift it to the right toward the position shown in Figure 2, which illustrates the extreme righthand position of the parts. At the end of the initial movement and before the piston 17 has been moved, the toggle linkage will be substantially straightened out to the position shown in Figure 2 and the pins 28 will be directly in front of the slots 32 and break close to the entrances thereof. Upon initial movement of the piston 17, the entire toggle linkage will be shifted bodily to the right to move the pins 28 into the slots 32 which act as fixed cam surfaces to hold the toggle linkage in its extended position. It will be noted that the toggle linkage is never completely straightened out so that when the force is exerted on the right end thereof in compression, it will collapse to the position shown in Figure 1 after the pins 28 have moved out of the slots 32. During continued movement to the right, however, the toggle linkage is held extended by the camming effect of the slots 32 so that the extension 21 and the load will be moved by the large piston at a relatively low rate and with a high degree of force.

To return the parts to their initial position pressure on the connection 15 is relieved and operating fluid under pressure is supplied to the connection 16. This pressure acts on the right end of the annular piston 23 to urge the connection 21 and the small piston to the left. As long as the pins 28 remain in the slots 32, the toggle linkage cannot buckle so that the large piston will be moved back to the left to its initial position as shown in Figure 1 through the toggle linkage. As soon as the pins 28 move out of the slots 32, the toggle linkage will buckle due to the compressive force thereon allowing the small piston 19 to move to the left relative to the piston 17. This movement will continue until the parts reach the position shown in Figure 1 which constitutes their extreme lefthand position after which they are ready for a succeeding operation.

While one embodiment of the invention has been shown and described, it will be understood that this is illustrative only and is not to be taken as a definition of the scope of the invention, reference being had for this purpose to the appended claims.

What is claimed is:

1. A differential cylinder comprising a body formed with a first bore and a second bore of smaller diameter aligned with the first bore, a first piston slidable in the first bore, a second piston slidable in the second bore and having an extension projecting slidably through the first piston and adapted to be connected to a load, a connection to supply operating fluid to the second bore at the end thereof remote from the first bore to urge the second piston toward the first bore, the second piston moving out of the second bore to open the first bore to the connection whereby the first piston will be moved, an extensible linkage connected at its ends to the first piston and the extension to be extended when the second piston moves relative to the first piston, and holding means cooperating with the linkage and made effective by initial movement of the first piston to hold the linkage in its extended condition.

2. The construction of claim 1 in which the holding means comprises a cam surface fixed with respect to the body and engaging the linkage after initial movement of the first piston to hold the linkage in extended position.

3. A differential cylinder comprising a body formed with a first bore and a second bore of smaller diameter aligned with the first bore, a first piston slidable in the first bore, a second piston slidable in the second bore and having an extension projecting slidably through the first piston and adapted to be connected to a load, a connection to supply operating fluid to the second bore at the end thereof remote from the first bore to urge the second piston toward the first bore, the second piston moving out of the second bore to open the first bore to the connection whereby the first piston will be moved, a toggle linkage connected at its opposite ends to the first piston and the extension respectively to be extended as the second piston moves relative to the first piston, the linkage including an intermediate joint movable laterally of the pistons as the linkage is extended, and a cam surface fixed with respect to the body to engage said intermediate joint after initial movement of the first piston to hold the linkage extended during further movement of the pistons.

4. A differential cylinder comprising a body formed with a first bore and a second bore of smaller diameter aligned with the first bore, a first piston slidable in the first bore, a second piston slidable in the second bore and having an extension projecting slidably through the first piston and adapted to be connected to a load, a connection to supply operating fluid to the second bore at the end thereof remote from the first bore to urge the second piston toward the first bore, the second piston moving out of the second bore to open the first bore to the connection whereby the first piston will be moved, a toggle linkage including a pair of links having a common pivot connection at one end and pivoted at their other ends to the first piston and the extension respectively to be extended to a substantially straight position as the second piston moves relative to the first piston, and a cam surface fixed relative to the body to engage the common pivot connection after initial movement of the first piston and hold the linkage extended during further movement of the pistons.

5. A differential cylinder comprising a body formed with a first bore and a second bore of smaller diameter aligned with the first bore, a first piston slidable in the first bore, a second piston slidable in the second bore and having an extension projecting slidably through the first piston and adapted to be connected to a load, a connection to supply operating fluid to the second bore at the end thereof remote from the first bore to urge the second piston toward the first bore, the second piston moving out of the second bore to open the first bore to the connection whereby the first piston will be moved, an extensible linkage connected at its ends to the first piston and the extension to be extended when the second piston moves relative to the first piston, a cam surface fixed relative to the body and engaging the linkage after it is moved by initial movement of the first piston to hold the linkage extended, and return means acting on the extension of the second piston to move the first and second pistons in the opposite direction.

6. A differential cylinder comprising a body formed with a first bore and a second bore of smaller diameter aligned with the first bore, a first piston slidable in the first bore, a second piston slidable in the second bore and having an extension projecting slidably through the first piston and adapted to be connected to a load, a connection to supply operating fluid to the second bore at the end thereof remote from the first bore to urge the second piston toward the first bore, the second piston moving out of the second bore to open the first bore to the connection whereby the first piston will be moved, an extensible linkage connected at its ends to the first piston and the extension to be extended when the second piston moves relative to the first piston, a cam surface fixed relative to the body and engaging the linkage after it is moved by initial movement of the first piston to hold the linkage extended, the body being formed with a third bore through which the extension projects, an annular piston fitting slidably in the third bore, and a connection to supply fluid to the third bore at the side of the annular piston remote from the first bore to move the first and second pistons in the opposite direction.

7. A differential cylinder comprising a body formed with a first bore and a second bore of smaller diameter aligned with the first bore, a first piston slidable in the first bore, a second piston slidable in the second bore and having an extension projecting slidably through the first piston and adapted to be connected to a load, a connection to supply operating fluid to the second bore at the end thereof remote from the first bore to urge the second piston toward the first bore, the second piston moving out of the second bore to open the first bore to the connection whereby the first piston will be moved, a toggle linkage including a pair of links having a common pivot connection at one end and pivoted at their other ends to the first piston and the extension respectively to be extended to a substantially straight position when the second piston moves relative to the first piston,

a cam surface fixed relative to the body to engage the common pivot connection after the linkage has been moved by initial movement of the first piston to hold the linkage in its extended position, and return means acting on the extension to move the pistons in the opposite direction.

8. A differential cylinder comprising a body formed with a first bore and a second bore of smaller diameter aligned with the first bore, a first piston slidable in the first bore, a second piston slidable in the second bore and having an extension projecting slidably through the first piston and adapted to be connected to a load, a connection to supply operating fluid to the second bore at the end thereof remote from the first bore to urge the second piston toward the first bore, the second piston moving out of the second bore to open the first bore to the connection whereby the first piston will be moved, a toggle linkage including a pair of links having a common pivot connection at one end and pivoted at their other ends to the first piston and the extension respectively to be extended to a substantially straight position when the second piston moves relative to the first piston, a cam surface fixed relative to the body to engage the common pivot connection after the linkage has been moved by initial movement of the first piston to hold the linkage in its extended position, the body being formed with a third bore through which the extension projects, an annular piston on the extension fitting slidably in the third bore, and a connection to supply operating fluid to the third bore at the side of the annular piston remote from the first bore thereby to move the first and second pistons in the opposite direction.

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