Dec. 23, 1952 G. G. DRAGO 2,622,401

HYDRAULIC DRIVE MECHANISM FOR STEP-BY-STEP CONVEYERS

Filed July 16, 1949 2 SHEETS—SHEET 1

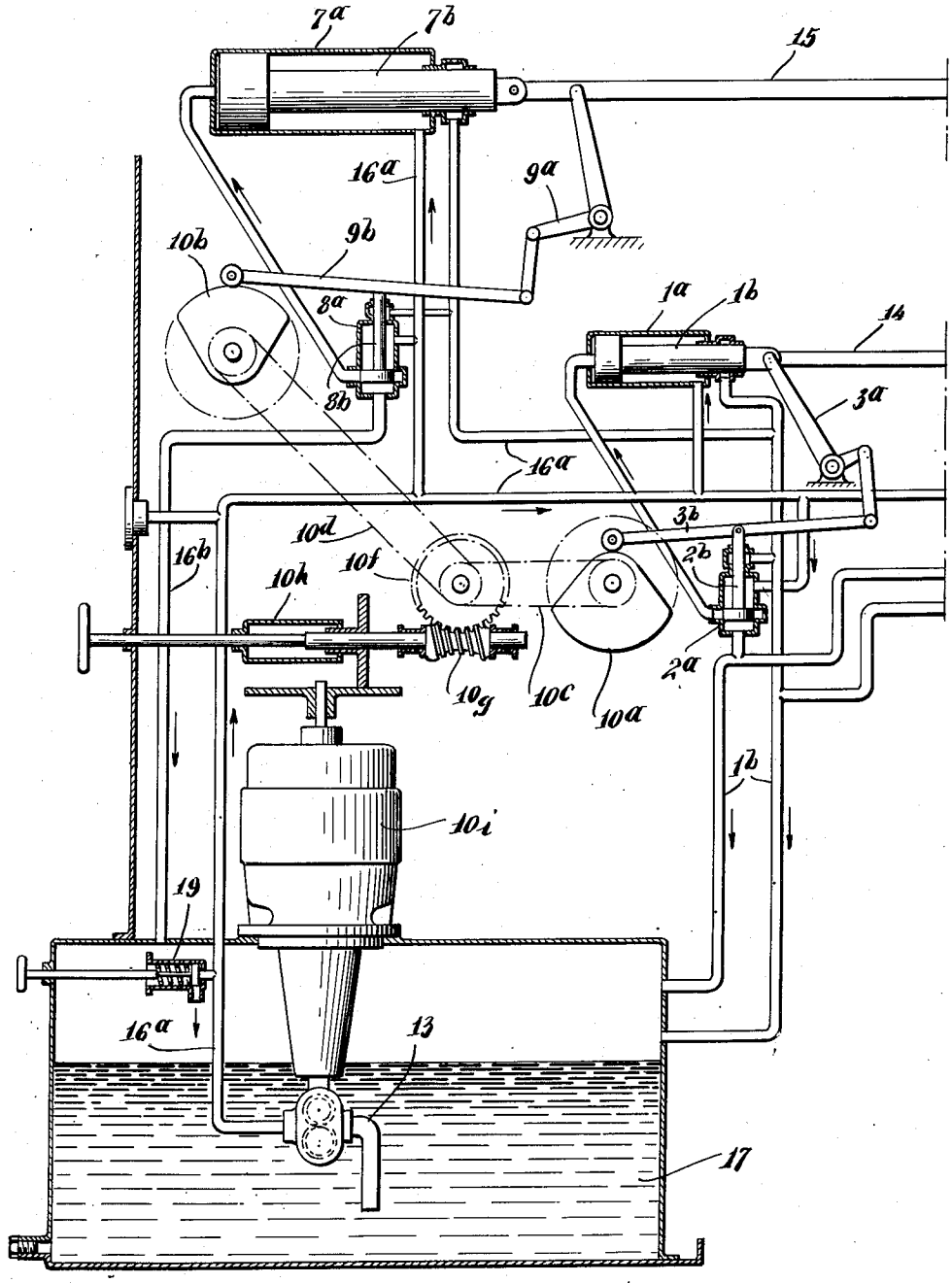

Fig. 1a.

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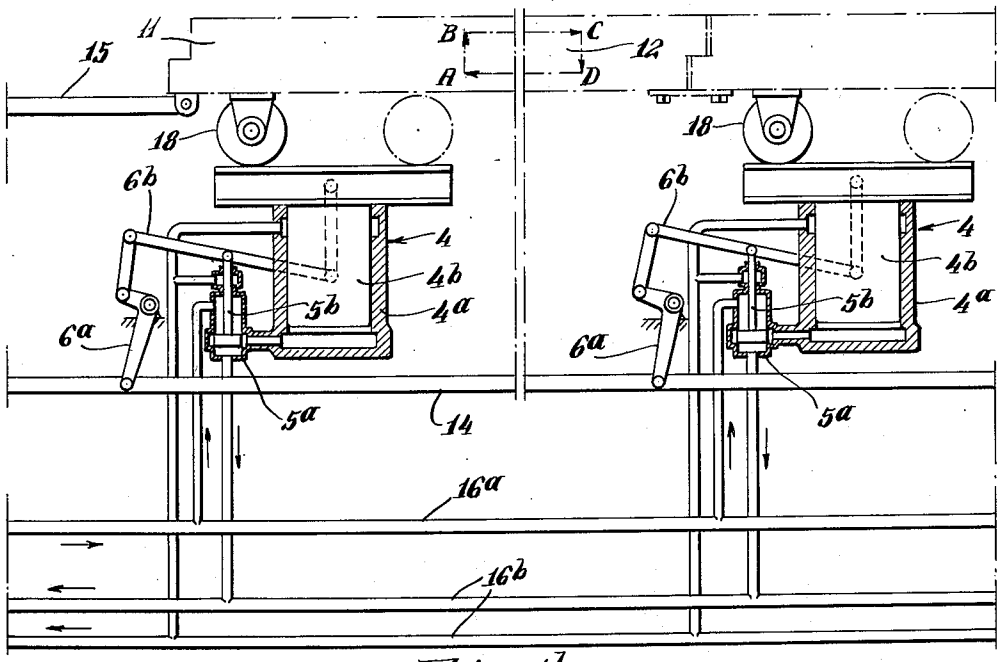

Fig. 1b.

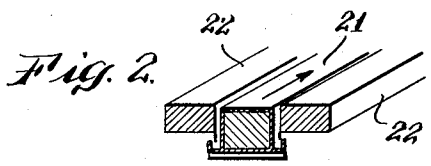

Fig. 2.

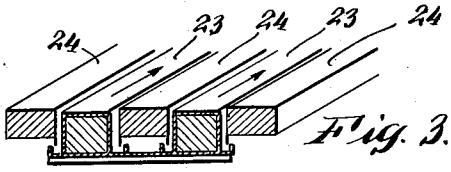

Fig. 3.

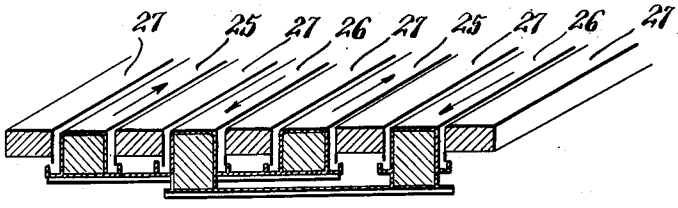

Fig. 4.

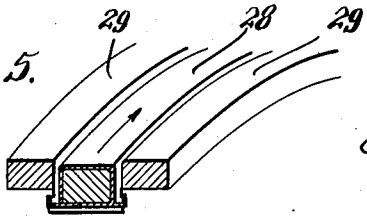

Fig. 5.

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HYDRAULIC DRIVE MECHANISM FOR STEP-BY-STEP CONVEYERS

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2 Claims. (Cl. 69—97)

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The present invention relates to a hydraulic drive system for step-by-step conveyors or the like, and more particularly for the conveyor floor of a kiln or drying tunnel.

It is known that the construction of drive systems for the conveyor floor of continuous drying kilns or tunnels is complicated by the fact that the parts must be constructed of durable and non-oxidizable metal. This limits the possibility of obtaining the higher temperatures at which the kilns operate more satisfactorily such as with electric heating elements.

In order to overcome this disadvantage step-by-step conveyors have been designed having one or more longitudinal movable elements placed in parallel and in series. These elements may be constructed of materials other than metal and they act as a shield for the metal parts which control their movements. It is customary to control the movements of such step-by-step movable elements by mechanical means which are of complex and expensive construction, particularly where kilns of great length are involved.

The principal object of this invention is to provide a step-by-step conveyor of the type described wherein the movements are controlled by hydraulic means. It is known that hydraulic power can be transmitted to any required distance simply by extending a fluid pipe line, and this advantage enables the conveyor according to the present invention to be adapted to any length of kiln.

In one form of hydraulic drive system according to the present invention there are provided a series of means controlling the vertical movement of a plurality of horizontal longitudinally movable elements and means controlling longitudinal movement thereof.

The vertical movement of the elements, which may be referred to as traveling beams, is obtained by a hydraulic servo-motor acting as a pilot to supply fluid to a plurality of vertically reciprocating pistons. This servo-motor is controlled by a slide valve actuated by a cam operated by a drive motor.

The longitudinal movements of the traveling beams are controlled also by a servo-motor to which the supply of fluid is controlled by a slide valve similarly actuated by a cam operated from the same drive motor.

The traveling beams forming the conveyor are supported and conveyed along the heads of the vertically reciprocating pistons by means of rollers cooperating with a system of guide rails or with an adjacent parallel traveling beam.

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The system further includes an hydraulic pump, preferably driven by the same motor as the above mentioned cams, and a system of supply and discharge conduits from the pump to the slide valves, servo-motors and pistons and return or discharge conduits therefrom to a sump from which the pump draws fluid to supply it under pressure through the supply lines.

In the accompanying drawings Figures 1*a* and 1*b* illustrate diagrammatically a complete drive system in accordance with the invention and Figures 2–5 illustrate the movements of the traveling beams controlled by the system of Figure 1.

In Figure 1 there is shown a servo-motor comprising a cylinder 1*a* having a piston 1*b* slidable therein. The piston 1*b* is of the differential type having a circular face at the left hand side of larger surface than a second annular face at the right. The movements of the piston 1*b* in the cylinder 1*a* are controlled by a slide valve 2*a* having a valve member 2*b* reciprocating therein. The movements of the valve member 2*b* are controlled on the one hand by a bell crank lever 3*a* and a linkage system 3*b* and by a cam 10*a* acting on the linkage system 3*b*. The bell crank lever 3*a* is connected to a rod 14, the movements of which correspond to the movements of the piston 1*b* and the operation of which will be described hereinafter.

In the position shown in the drawing, the valve member 2*b* closes the supply port of the slide valve 2*a* interrupting the supply of fluid under pressure to the left hand side of the cylinder 1*a*. Upon rotation of the cam 10*a* the slide member 2*b* will be lifted by the linkage system 3*b* and fluid will be supplied to the cylinder 1*a*. Since the right side of the cylinder 1*a* is in permanent communication through conduits 16*a* with the supply side of a pump 13, and since the piston 1*b* is of the differential type, the supply of fluid under pressure through the slide valve 2*a* to the left hand side of the cylinder 1*a* will cause movement toward the right of the piston 1*b*. Movement toward the right of the rod 14 with the piston 1*b* will cause clockwise rotation of the bell crank lever 3*a* and lowering of the valve member 2*b* thereby interrupting the supply of fluid under pressure to the cylinder 1*a*.

At the same time the movement to the right of the rod 14 will cause counterclockwise rotation of each one of a series of bell crank levers 6*a* connected to the rod 14 at spaced points thereof. The rod 14 extends longitudinally throughout the length of the conveyor beneath which there

are provided at spaced points a series of lifting motors 4 each comprising a cylinder 4a and a piston 4b reciprocating therein. The pistons 4b of the motors 4 are each connected by a linkage system 6b with the bell crank lever 6a and with the valve members 5b of a corresponding series of slide valves 5a controlling the supply of fluid under pressure to the cylinders 4a. Such counterclockwise movement of the bell crank levers 6a will lower the valve members 5b from the position shown in the drawing to open the supply ports and deliver fluid under pressure to the lower end of the cylinders 4a from the supply conduit 16a, thus causing upward movement of the pistons 4b.

When the piston 1b and rod 14 have been moved to the right as described, the pistons 4b being raised in response to such movement, and the valve member 2b being lowered also in response to the movement of the rod 14, the part of the mechanism so far described is arrested in that position. The system also comprises a servo-motor consisting of cylinder 7a having a piston 7b movable therein, which is preferably also of the differential type. The movements of this piston 7b are controlled by a slide valve 8a having a valve member 8b movable therein. A rod 15 connected to the piston 7b is movable in unison therewith and to the rod 15 there is connected a bell crank lever 9a controlling the movements of a linkage system 9b connected to the valve member 8b and operatively connected to a further cam 10b. Cams 10a and 10b are driven by chains or belts 10c and 10d from a double sprocket or pulley 10e rotated by a gear 10f and worm 10g from a drive motor 10i through a variable friction coupling 10h.

The angular relationship of the cams 10a and 10b are so timed that when the cam 10a has been rotated to perform the function previously described, the linkage 9b will be actuated by the cam 10b to lower the valve member 8b and open the supply port of the slide valve 8a and deliver fluid under pressure to the left side of the cylinder 7a thereby actuating the piston 7b and rod 15 to the right. Movement of the rod 15 to the right will rotate the bell crank lever 9a in a clock-wise direction and raise the valve member 8b to close the supply port and interrupt the delivery of fluid to the left side of the cylinder 7a.

A series of conveyor members or elements 11 previously described as traveling beams are supported on the heads of the pistons 4b by means of rollers 18, and movement of the rod 15 from the left to the right will propel the conveyors from the position of the rollers shown in full lines to the position shown in broken lines.

The pump 13 continuously driven by the motor 10i draws fluid from a sump 17 to deliver it under pressure through a supply conduit system 16a to the right side of the cylinders 1a and 7a and to the slide valves 2a, 5a and 8a. A return or discharge conduit system 16b is connected to each of the slide valves 2a, 5a and 8a and to the cylinders 4a for returning fluid therefrom to the sump. The supply conduit system 16a may be provided with an automatic or manually operated relief valve 19 for by-passing the drive system and returning the fluid to the sump.

When the system has been actuated to the positions where the cams 10a and 10b have been rotated 180°, namely to the position where all the pistons 4b are raised and the traveling beam 11 has been moved to the right, further rotation of the cams 10a and 10b will actuate the mechanism for a return stroke. The diagram 12 in Figure 1 shows 4 movements of the traveling beam 11. In the position illustrated in Figure 1 the traveling beam is at the point A of the diagram and the actuation of the servo-motor 1a, 1b and of the pistons 4b will bring the traveling beam to the position B. Actuation of the servo-motor 7a, 7b will bring the traveling beam from the position B to the position C.

It will be understood that the cams 10a and 10b may be provided with a desired number of dwells and rises having a suitable angular relationship to each other and to the dwells or rises of the other cam in order to supply and discharge pressurized fluid to and from the slide valves 2a, 5a and 8a, and thereby to the cylinders 1a, 4 and 7a in any desired sequence. After each actuation of the pistons 1b and 4b there is a period of rest during which the piston 7b is actuated and thus the diagram 12 may be completed by a downward stroke of the pistons 4b corresponding to movement between the points C and D and a return horizontal stroke of the rod 15 corresponding to movement between the points D and A. During such return strokes, the left hand sides of the cylinders 1a and 7a and the lower end of the cylinder 4 are placed in communication through their respective slide valves with the discharge or return conduit system 16b so that the fluid under pressure continuously supplied to the right side of each of the cylinders 1a and 7a will return the pistons 1b and 7b to the positions shown in Figure 1.

In Figure 2 there is shown a traveling beam 21 between two fixed parallel guides 22. The traveling beam is in its position of rest corresponding to the point A and the sequence of operation will first raise it and then move it in the direction of the arrow. In Figure 3 there are shown two traveling beams 23 with intervening fixed guides 24 from which they will first be raised by a common piston 4b and then propelled in the direction of the arrows.

In Figure 4 there are shown paired traveling beams 25 in the position corresponding to point A and paired traveling beams 26 in the position corresponding to point D, with intervening fixed guides 26. The traveling beams 25 will move in one direction while the beams 26 move in the opposite direction.

Figure 5 indicates that a traveling beam 28 of curved shape may be positioned between two curved guides 29 instead of in the rectiliner form illustrated in Figures 2–4. It will be understood that a drive system as illustrated in Figures 3, 1a and 1b is provided in parallel relationship for each of a plurality of parallel beams 21 as illustrated in Figure 2 or for each pair of traveling beams 23 illustrated in Figure 3 or 25 on the one hand and 26 on the other hand illustrated in Figures 3 and 4. For each such drive system it will be necessary to provide only a part of the drive system namely a servo-motor 1a, 1b with control valve 2a and cam 10a, a series of lifting motors 4 with control valve 5b and actuating rod 14 and a servo-motor 7a, 7b with control valve 8a and cam 10b. The same driven motor 10i and pump 13 may supply the motive power to all of the cams 10a, 10b and respectively the hydraulic power to all of the servo-motors and lifting motors.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:

1. A device for causing advancement of objects in a tunnel kiln, comprising a plurality of elements each of which is supported in a horizontally slidable relation by a plurality of first pistons contained in cylinders, and is connected to a further piston in a further cylinder actuating a horizontal displacement of said element, pipes for feeding a pressurized liquid to and discharging said liquid from both ends of said cylinders, valves controlling the flow of said liquid to and from the ends of said cylinders, levers one point of each of which is connected to one of these valves for controlling the position of the latter, another point is operatively connected to the corresponding first piston, and a control mechanism connected to a third point of each of said levers for displacing the same successively and alternately in the opposite directions.

2. A device as claimed in claim 1, in which the said control mechanism comprises a rod for displacing simultaneously all the third points of the levers connected to the first mentioned supporting pistons, a further piston operating in a further cylinder for moving said rod, pipes for feeding a pressurized liquid to and discharging it from both ends of the last said cylinder, a valve controlling the flow of said liquid to and from the ends of the last said cylinder and a lever one point of which is connected to this last mentioned valve for controlling the position thereof, another point is operatively connected to the last said piston, and a third point is operatively connected to said control mechanism.

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No references cited.