Nov. 17, 1931. H. ERNST ET AL 1,832,694

AUXILIARY MANUAL MEANS FOR ACTUATING HYDRAULIC MOTORS

Original Filed Sept. 15, 1927 2 Sheets-Sheet 1

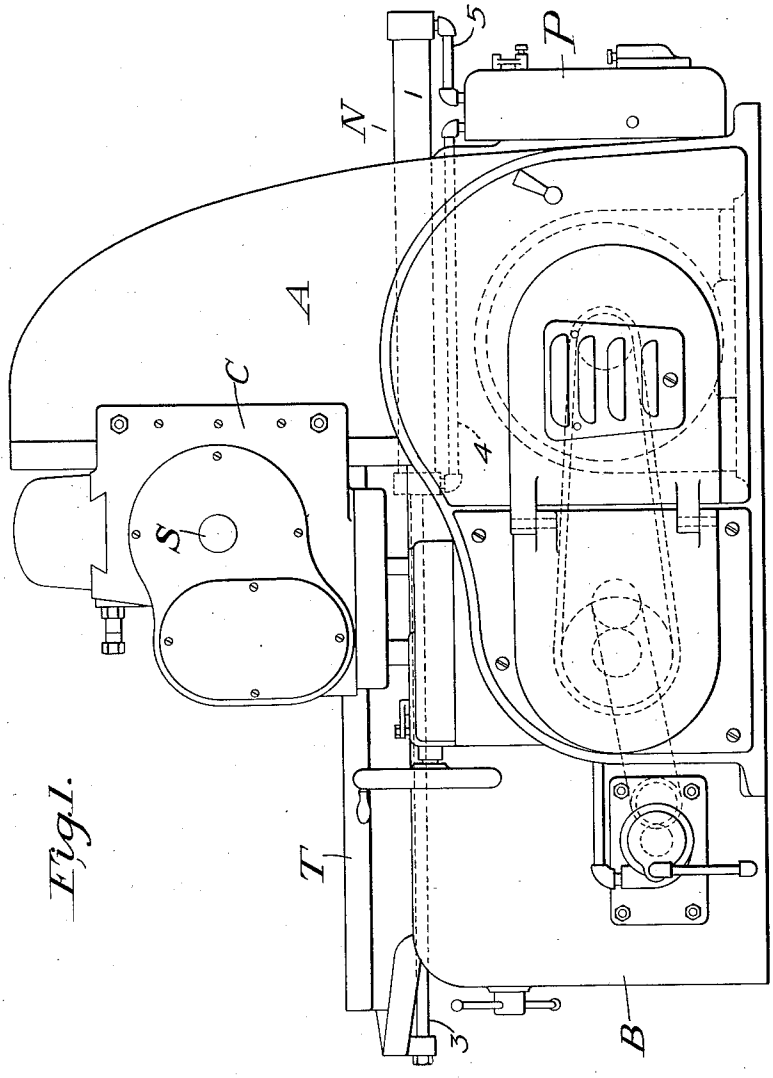

Fig. 1.

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Fig. 2.

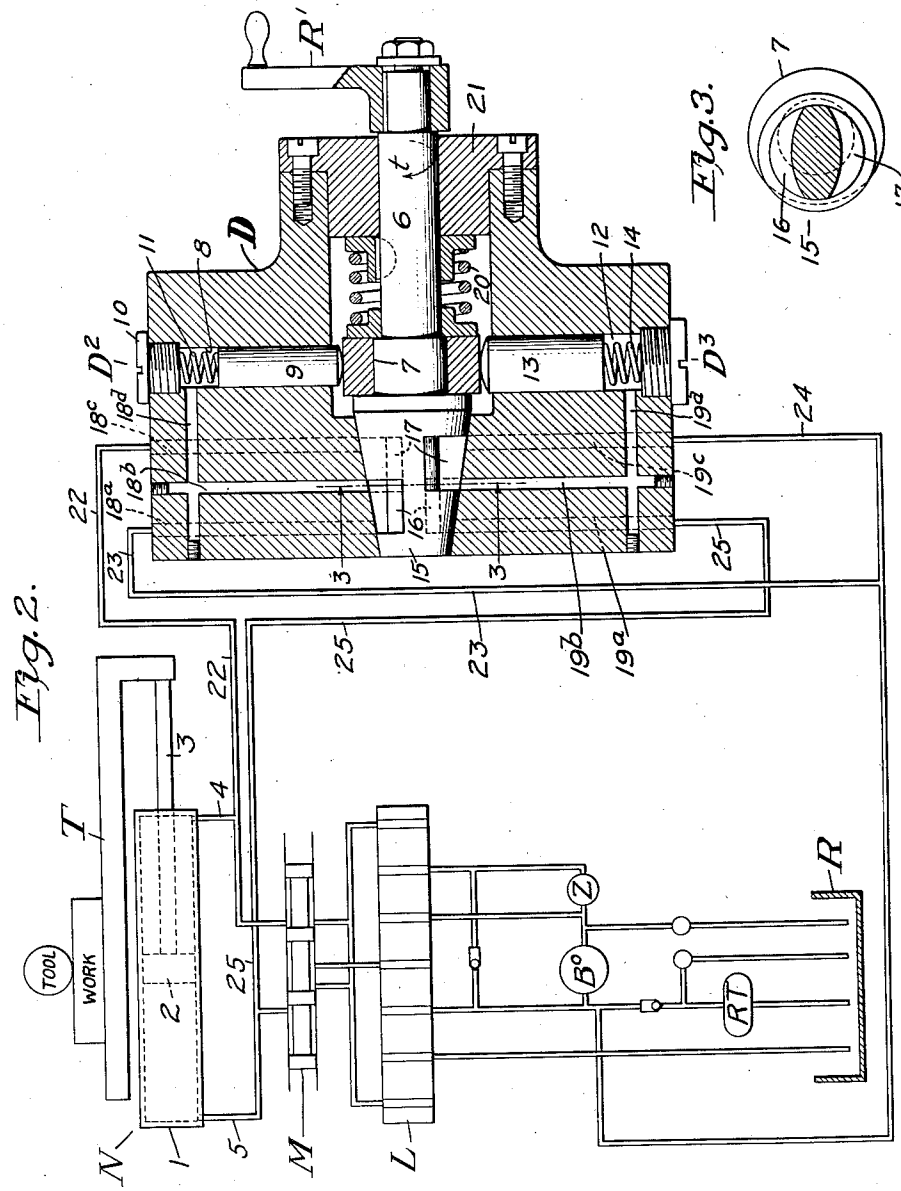

Fig. 3.

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UNITED STATES PATENT OFFICE

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AUXILIARY MANUAL MEANS FOR ACTUATING HYDRAULIC MOTORS

Original application filed September 15, 1927, Serial No. 220,721. Divided and this application filed December 18, 1928. Serial No. 326,843.

One of the difficulties experienced in the operation of hydraulically actuated machine tools arises from the fact that, as heretofore constructed, the hydraulic systems have not provided any simple, yet effective, means for initially positioning the tool relative to the work-piece, as is frequently necessary in setting up a work-piece, nor have they provided any conveniently operated means, under manual control, for effecting feeding movement of the translated member when, as for example, it is desired to machine, with great precision, to a line or wall.

This invention has for an object to render available a hydraulic system which will have all of the advantages common to such systems and which, in addition, will obviate the difficulties and disadvantages heretofore encountered in their operation.

More specifically stated this invention has for an object to provide auxiliary manual means for actuating a hydraulic system, which means may be operated with as little inconvenience and difficulty as may be the usual manual feed commonly provided in connection with automatic mechanical feeds.

A further object of the invention is to provide auxiliary manually operated means for actuating a hydraulic system and so to combine said auxiliary means with a conventional power operated and automatically controlled fluid pressure system that the manual means will be capable of operation both in combination with the power means and also independently thereof.

Another object of this invention is to provide manually operated means for actuating a hydraulic motor and so to construct said means as automatically to compensate for the amount of fluid displaced from one end of the motor by the usual piston rod, to the end that uniform actuation of the manual means in opposite directions will effect uniform translation, in opposite directions, of the actuated member.

The objects of this invention have been attained by embodying in an automatically controlled hydraulic system a stop valve adapted upon actuation to isolate the hydraulic motor from the main power driven pump and by combining therewith a manually actuable pump (or pumps) adapted to draw fluid from one end of the hydraulic motor and to force fluid into the other end thereof, to effect translation of the piston in said hydraulic motor and thereby to effect feeding movements of the work-table. Preferably the manual feed of the table is effected by means of a compound pump having two cylinders both connected with a source of fluid supply and each of which is connected with only one end of the hydraulic motor. These pumps are of unequal capacity, the one having the lesser capacity being connected with that end of the hydraulic motor containing the piston rod, whereby the pumps by their unequal capacity, automatically compensate for the difference in capacity in the opposite ends of the motor due to the presence of the piston rod in one end only and effect movement of the table at a uniform rate, in opposite directions.

The automatically controlled hydraulic system to which this invention is applied is clearly illustrated and described in our pending United States patent application, Ser. No. 220,721, filed September 15, 1927 of which this application is a division.

Other objects and advantages will be in part indicated in the following description and in part rendered apparent therefrom in connection with the annexed drawings.

To enable others skilled in the art so fully to apprehend the underlying features hereof that they may embody the same in the various ways contemplated by this invention, drawings depicting a preferred typical construction have been annexed as a part of this disclosure and, in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:—

Figure 1 is a side elevation of a hydraulically actuated milling machine embodying the present invention. Fig. 2 is a sectional view of the manually actuable pump for actuating the hydraulic motor and illustrating diagrammatically the automatically actuated system with which it is combined. Fig. 3 is a detail sectional view through the pump

controlling valve, taken on the line 3—3 of Fig. 2.

Referring more specifically to the drawings, the invention is disclosed as embodied in a milling machine comprising a base B; a translatable work-table T slidably mounted on said base; a standard A adjustably supporting a carriage C, and a tool spindle S journaled in said carriage. Reciprocatory motions are given to the table T by means of a hydraulic motor N comprising a cylinder 1 fixed to the base B, and a piston 2 slidingly fitted within said cylinder and connected with said table by piston rod 3. Conduits 4 and 5 connect opposite ends of the cylinder with a mechanically actuated and automatically controlled pump unit designated generally as P. As described in our pending application, Ser. No. 220,721, this pump unit may house a rapid traverse pump RT, a variable displacement pump Z and a booster pump B^0 connected, at certain times, by means of an automatically actuated main control valve L and suitable conduits, with the hydraulic motor N. These pumps are adapted to pass fluid originally contained in a reservoir R located within the machine base. The construction and action of the pumps RT, B^0 and Z and the main control valve L are clearly shown and described in the parent application above referred to and inasmuch as they form no part of this invention detailed illustration and description thereof is deemed unnecessary in this application.

Embodied in the hydraulic system, intermediate the main control valve L and the hydraulic motor, is a stop valve M adapted, in conjunction with the main valve, to isolate the pumps RT, B^0 and Z from the hydraulic motor to discontinue movement of the work-table under the influence of said pumps. The means for shifting the valve M to its various positions is clearly shown and described in the application above referred to and inasmuch as such means forms no part of this invention detailed illustration and description thereof is deemed unnecessary herein.

In addition to the hydraulically actuated and automatically controlled feed device for the work-table, this invention also provides improved manually actuated feed therefor by means of which relative movement between the tool and the work may be effected and controlled with great accuracy. A device of this nature is particularly useful for effecting an initial positioning of the tool and work and also to feed the work-table when it is desired to machine to a line with great precision. Fig. 2 discloses a manually actuated auxiliary pump and valve mechanism which readily may be combined with the mechanically actuated and automatically controlled table feed hereinbefore referred to. This manual feed comprises a combined pump and valve casing D within which is rotatably journaled a short shaft 6 having secured to its outwardly projecting end a hand crank R'. Intermediate its ends, the shaft 6 is provided with an eccentric 7 which serves as the actuating element for two opposed pumps D^2 and D^3 of unequal capacity. The eccentric may consist of a unitary element but preferably it will comprise two parts, one the eccentric proper and the other a suitable wear ring surrounding the eccentric element. The pump D^2 comprises a cylinder 8 formed in the casing D and a piston 9 slidingly fitted therein, the inner end of the piston engaging the periphery of the eccentric 7 and receiving outward reciprocatory motion therefrom. The outer end of the cylinder is closed as by a cap screw 10, and a coil spring 11, interposed between the screw and the piston, exerts an inward pressure on the piston maintaining it in contact with the eccentric and causing the piston to be retracted as the periphery of the eccentric recedes. The pump D^3 comprises a cylinder 12 also formed in the casing D, a piston 13 operable in the cylinder by means of the eccentric 7 and a coil spring 14 which functions the same as the spring 11. A cone valve 15 for controlling the intake and exhaust of the cylinders 8 and 12 is fixed to the shaft 6 and rotates synchronously with the eccentric 7. This valve includes disconnected arcuate ports 16 and 17 which overlap in the direction of the axis of the valve as shown in Fig. 2. The valve casing is formed, at one side, with three parallel ports 18^a, 18^b and 18^c and a transverse duct 18^d connected with the cylinder 8, and at the oposite side with three ports 19^a, 19^b and 19^c and a transverse duct 19^d connected with the cylinder 12. A coil spring 20 interposed between washers abutting the eccentric 7 and a flanged bushing 21 secured within the casing serves to maintain the cone valve in its conical seat. The pump D^2 serves, upon rotation of the crank R', in the direction indicated by the arrow *t*, in Fig. 2, to withdraw measured amounts of fluid from the right end of the feed cylinder 1. During this pumping action the fluid flows from the feed cylinder, through pipe line 22, through ports 18^c, 17, 18^b and duct 18^d into the cylinder 8 during the intake stroke of the piston 9. Upon rotation of the crank R' and the eccentric 7, to effect exhaust movement of the piston 9, the valve 15 is rotated to bring the ports 16 and 17 into the position shown in full lines in Fig. 2. This affords passageway from the cylinder 8, comprising the duct 18^d, ports 18^b, 16 and 18^a, through which the fluid is ejected into a pipe line 23 from which it is exhausted. Simultaneously with the action of the pump D^2, the pump D^3 acts to draw fluid, in measured amounts, from any suitable source, such for example as the exhaust line of the rapid traverse pump, and injects it into the left end

of the feed cylinder, thereby causing the piston, and the work-table connected therewith, to be shifted to the right. Upon retraction of the piston 13, fluid is drawn into the cylinder 12, through a pipe line 24, ports 19^c, 17, 19^b and duct 19^d. Upon rotation of the eccentric 7 to depress the piston 13 the valve 15 is moved to bring the port 16 into the position shown in dotted lines and as the piston is depressed the fluid within the cylinder is exhausted through the duct 19^d, ports 19^b, 16, 19^a and through pipe line 25 into the left end of the feed cylinder. Thus it will be perceived that one of the manually actuated pumps acts as a propelling means for the hydraulic motor while the other acts as a metering device to permit fluid to escape from the exhaust end of the motor in measured amounts so that the movable element of the motor may be moved under the influence of said propelling means.

Upon rotation of the crank R' in the direction reversed to that just described, the pumps D^2 and D^3 operate in a reverse manner thereby withdrawing fluid from the left end of the feed cylinder and injecting fluid into the right end thereof, thus causing the piston and the work-table connected therewith to be moved toward the left.

To insure that the table will be moved at uniform speeds in opposite directions, the pistons 9 and 13 preferably are formed of sizes bearing the same ratio as the effective cross sectional areas of the two ends of the feed cylinders which, it will be perceived, are unequal due to the fact that one end of the feed cylinder contains the piston rod.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various utilizations by retaining one or more of the features that, from the standpoint of the prior art, fairly constitute essential characteristics of either the generic or specific aspects of this invention and, therefore, such adaptations should be, and are intended to be, comprehended within the meaning and range of equivalency of the following claims:—

Having thus revealed this invention, we claim as new and desire to secure the following combinations and elements, or equivalents thereof, by Letters Patent of United States:—

1. A machine tool combining work and tool carriers; power driven hydraulic means for shifting one of said carriers; and a manually operable pump device for transferring fluid from an inlet to an outlet side of said means, and conversely, for accomplishing an adjustment in the position of said carrier.

2. A machine tool combining work and tool carriers; power driven hydraulic means for shifting one of said carriers; a valve adapted to prevent circulation of fluid through said hydraulic means, thereby hydraulically locking said carrier; and a manually operable pump device for transferring fluid from an inlet to an outlet side of said means, and conversely, for accomplishing an adjustment in the position of said carrier.

3. A machine tool combining a relatively stationary member; a member adjustable thereon; a hydraulic cylinder fixed to one of said members; a piston in said cylinder and connected with the other of said members; a manually actuated double pump mechanism comprising two pumps connected, respectively, with the opposite ends of said cylinder, one of said pumps being adapted, upon actuation, positively to force fluid into one end of said cylinder and the other pump acting simultaneously therewith to permit limited exhaust from the opposite end of said cylinder by removing measured amounts of fluid therefrom, thereby to effect relative movement between the cylinder and piston and consequently adjustment of said shiftable member.

4. A machine tool combining a relatively stationary member; a member adjustable thereon; a hydraulic cylinder fixed to one of said members; a piston in said cylinder and connected with the other of said members by means of a piston rod; two simultaneously and manually actuable pump mechanisms of unequal capacity connected with the opposite ends of said cylinder, one of said pumps acting to force fluid into one end of cylinder and the other acting to permit fluid to be exhausted from the other end of the cylinder at a predetermined rate, the ratio of capacity of the two pumps being substantially equal to the unequal capacity, per unit of length, of the opposite ends of the cylinder due to displacement caused by the piston rod.

5. A machine tool as set forth in claim 4 in which the manually actuated pump includes a rotatable actuating crank; a manually actuated valve mechanism operated in timed relation with the actuation of the pumps, and which, upon rotation of the crank in one direction, causes fluid to be injected into the left end of the cylinder and exhausted from the right end; and which reverses the action of the pumps when the crank is turned in the opposite direction.

6. A machine tool combining a reciprocable table; power actuated hydraulic means for reciprocating said table, said means comprising a relatively shiftable cylinder and piston, one of which is stationary and the other of which is connected with the cylinder for subjecting one end of said cylinder to substantial fluid pressure; escapement means to permit limited amounts of fluid successively to be exhausted from the opposite end of said cylinder; means to discontinue the flow of fluid through said fluid pressure line and to render ineffective said escapement means;

and an auxiliary manually actuated hydraulic means connected with opposite ends of said cylinder for similarly effecting movement of said table.

7. In a machine tool, a member to be translated, a hydraulic motor mechanically connected with said member; two pumps, one hydraulically connected with one end of said motor and the other hydraulically connected to the other end thereof; manually actuated means for operating said pumps to cause one of said pumps to force fluid into one end of said motor and simultaneously therewith to operate the other of said pumps to cause it to effect exhaust, in measured amounts, from the other end of said motor.

8. In a machine tool, a member to be translated; a hydraulic motor for translating said member, said motor comprising a cylinder, a piston slidable in said cylinder, and a piston rod connecting said piston with the member to be translated; two pumps of unequal capacity hydraulically connected with said cylinder at opposite ends of said piston, the capacity of the pumps being proportionate to the unequal capacity of the opposite ends of the cylinder, per unit of length, due to the presence of the piston rod in one end only of the cylinder; and manually actuated means synchronously to operate said pumps to cause one to effect exhaust of fluid, in measured amounts, from one end of the cylinder while the other pump is injecting fluid into the other end of the cylinder.

9. In a machine tool, a member to be translated, a hydraulic motor mechanically connected with said member; a source of fluid supply; two pumps, each of which is connected with said source and both of which are hydraulically connected with one end only of said hydraulic motor; a common actuator for both of said pumps, said actuator serving to effect intake of one pump during the exhaust of the other pump; manual means for operating said actuator; and valve means movable in timed relation with said actuator for connecting one of said pumps with one end of said motor during its intake stroke and simultaneously therewith connecting the other pump to the other end of the motor.

10. A device of the character set forth in claim 9 in which the pumps, the valve, and the pump actuator are so constructed and coordinated that continuous rotation of the manual operating means causes one pump periodically to draw measured amounts of fluid from its source and inject it into one end of the motor while the other pump periodically receives fluid in measured amounts from the other end of said motor and returns it to said source.

11. In a machine tool, a member to be translated; a hydraulic motor to translate said member; a source of fluid supply; a pump having an intake port connected with one end of said motor and an exhaust port connected with said source of fluid supply; a second pump having its intake port connected with said source of fluid supply and its exhaust port connected with the other end of said motor; a manually rotatable eccentric device adapted, during its rotation to actuate both of said pumps, said pumps being arranged 180° apart about the axis of said actuator whereby one pump intakes while the other exhausts; and a valve mechanism rotatable with said eccentric device and adapted during rotation thereof alternately to connect each pump first with its intake port and then with its exhaust port.

In witness whereof, we have hereunto subscribed our names.

HANS ERNST.
LESTER F. NENNINGER.