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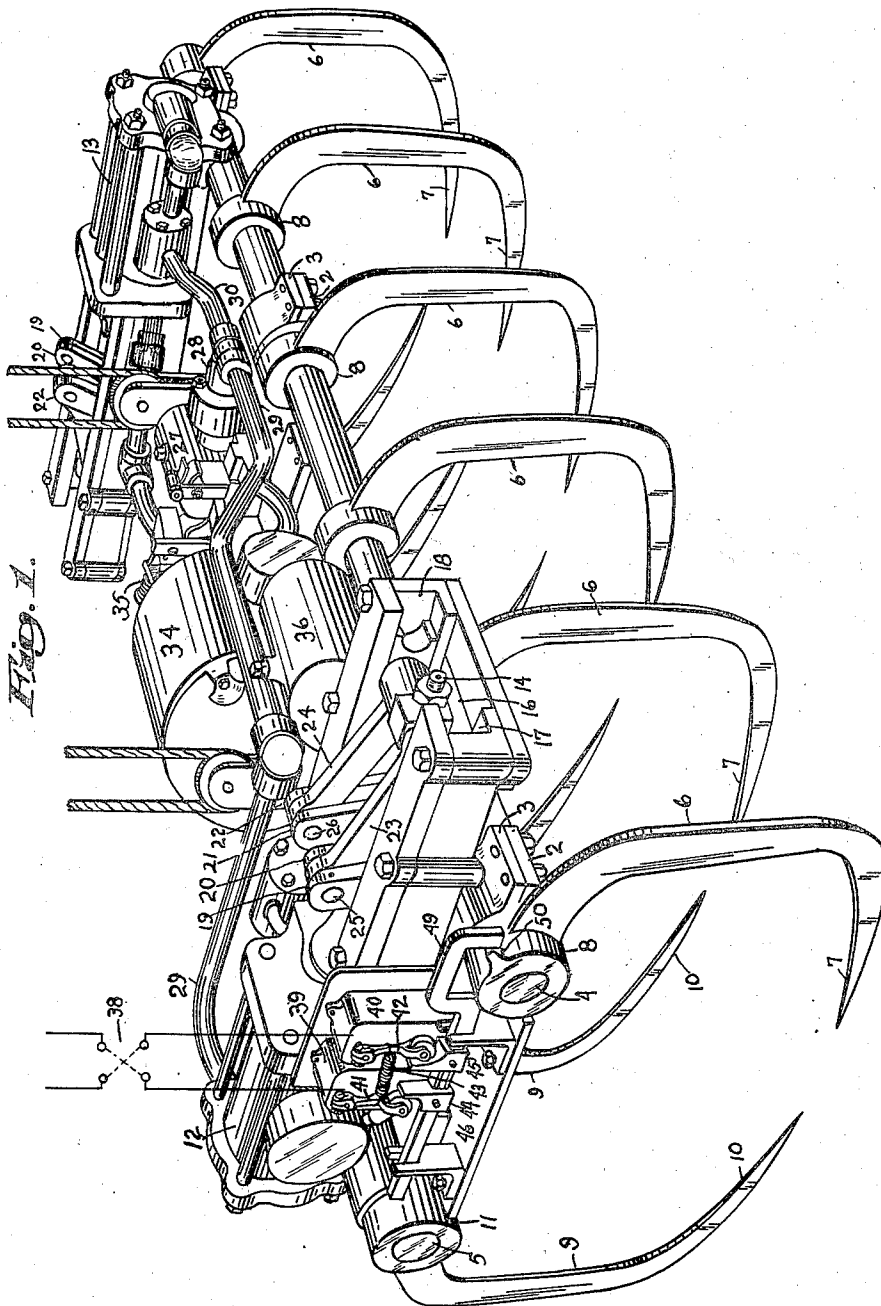
A. M. STEVENS

2,412,845

GRAPPLE FORK

Filed June 9, 1945

3 Sheets-Sheet 1



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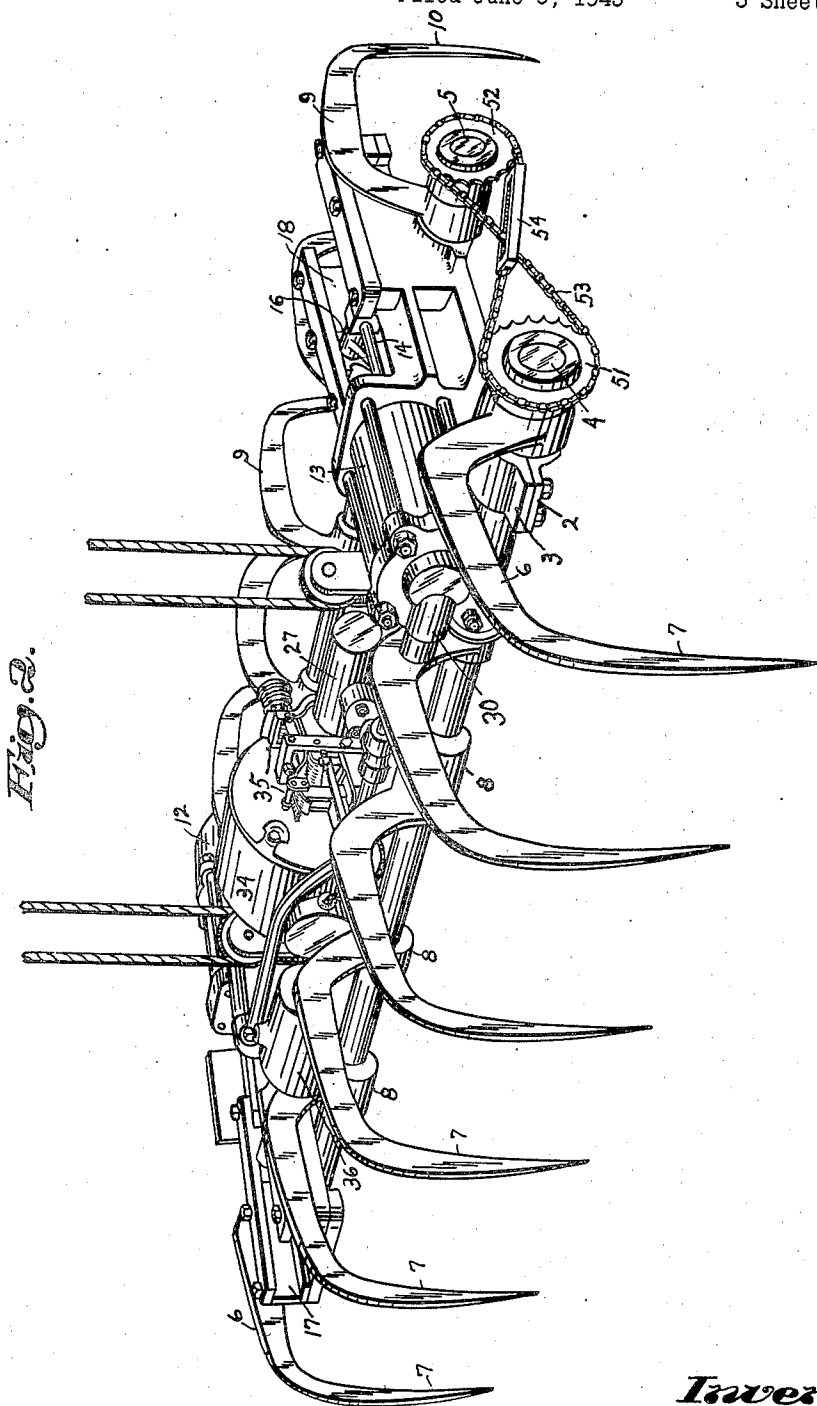
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3 Sheets-Sheet 2



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Fig. 3.

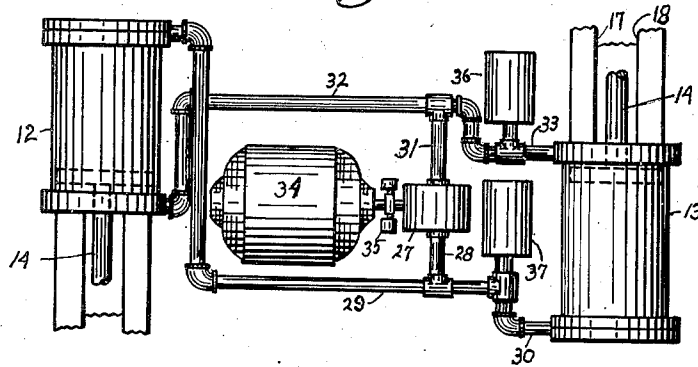


Fig. 4.

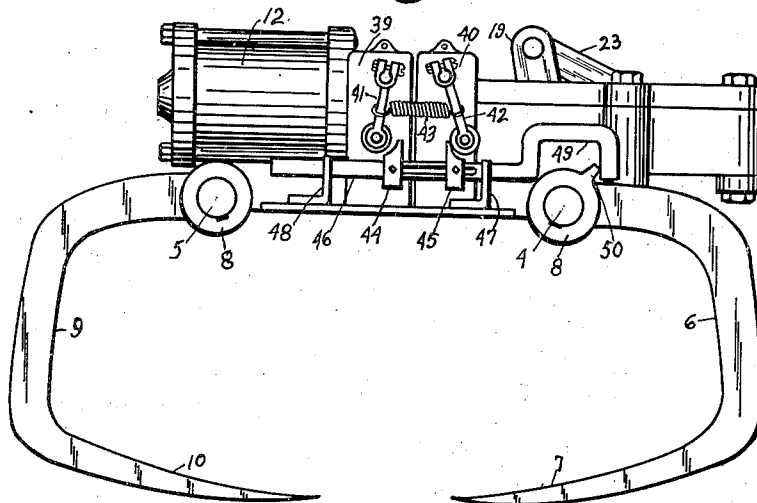
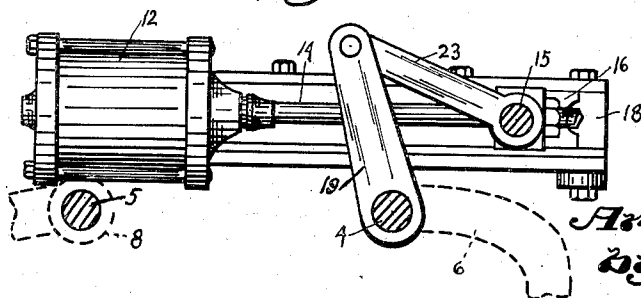


Fig. 5.



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UNITED STATES PATENT OFFICE

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GRAPPLE FORK

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11 Claims. (Cl. 294—88)

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This invention relates to improvements in vertically movable grapple forks and the general object of the invention is to provide a well balanced grapple fork having parallel rock shafts provided with complementary hook-shaped tines and reversely arranged simultaneously operated power applying units mounted upon opposite end portions of the frame for actuating the respective rock shafts to swing the tines toward and from each other and to insure uniform penetration of the tines into the material to be conveyed by the grapple fork.

A further object of the invention is to provide a grapple fork of the construction described with means for co-ordinating the swinging movement of the respective tines to insure equal penetration of the cooperating tines into the material to be conveyed.

More specifically the object of the invention is to provide a grapple fork of the character described in which the rock shafts are respectively actuated by reversible fluid operated cylinders, preferably in the form of a rotatable pump driven by a reversible electric motor for forcing liquid, such as oil, under pressure into the larger end portions of the cylinders of an hydraulic motor and simultaneously exhausting liquid from the inner cylinders thereof to force the tines into the material, and conversely to reverse the direction of flow of the liquid to swing the tines out of engagement with the material.

Another object of the invention is to provide hydraulically actuated means of the character described with means for supplementing the amount of liquid under pressure supplied by the pump to the larger outer chambers of the respective cylinders than that which is exhausted from the inner chambers thereof, and preferably also to provide means for insuring uniformity of flow of the liquid through the pump irrespective of the direction of rotation of the pump.

Another object of the invention is to provide a grapple fork having hydraulically operated cylinder and piston mechanism for actuating the rock shafts having complementary tines, with means for preventing lateral strain upon the respective piston rods.

A further object of the invention is to provide switch mechanism in a circuit leading to the electric motor operable upon predetermined rotation of the rock shafts in either direction to arrest the swinging movements of the tines of the fork at predetermined conclusions of such movement.

These and other objects and features of the

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invention will more fully appear from the following description and the accompanying drawings and will be particularly pointed out in the claims.

A preferred embodiment of the invention is illustrated in the accompanying drawings, in which,

Fig. 1 is a perspective illustration of a grapple fork embodying the invention viewed from above and approximately diagonally of the grapple fork;

Fig. 2 is a like perspective illustration similarly viewed from the same side of the opposite end;

Fig. 3 is a detail view illustrative of the respective hydraulic cylinders, the reversible electric motor, the pump actuated thereby, the conduits leading from the pump to the respective inner and outer chambers of the cylinders, and the means for insuring proper circulation of the liquid to and from the chambers of the cylinder;

Fig. 4 is a detail elevation of one end of the grapple fork illustrating the means for actuating the stop switch mechanism; and,

Fig. 5 is a view partially in vertical section illustrating particularly the connection between the piston rod of one of the hydraulically operated cylinders and the shaft having the tines of one of the grapple forks the tines being illustrated in dotted lines.

The grapple forming the subject matter of the present invention is particularly designed for use with a crane for transporting masses of portable material, such as wool, from one place to another, and relates to the grapple fork mechanism of my prior application Serial Number 585,539 for patent on Wool storage and transporting mechanism, in which the general construction of the grapple is illustrated and described. The grapple comprises a frame, mainly in the form of a heavy rigid rectangular flat plate 1 having laterally projecting at suitably spaced intervals from the respective sides thereof a plurality of suitably formed extensions 2 provided with suitable caps 3 forming journals for rock shafts 4 and 5. A series of hook-shaped tines 6 having inwardly pointed ends 7 are provided with hubs 8 which are fixedly secured to the shaft 4 and a similar series of hook-shaped tines 9 provided with inwardly pointed ends 10 have hubs 11 which are similarly secured rigidly to the rock shaft 5, the shafts 4 and 5 extending in parallelism lengthwise of the frame.

The means for actuating the respective rock shafts comprise similar cylinders 12 and 13 which are reversely mounted transversely upon opposite

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end portions of the frame 1. Each of the cylinders 12 and 13 is provided with a piston having a piston rod 14, the outer end of which as illustrated in detail in Fig. 5 is connected by a wrist pin 15 to cross heads 16 which are reciprocally mounted in suitable guideways 17 and 18 which are bolted to the frame.

Each of the rock shafts 4 and 5 has rigidly secured to it upwardly extending pairs of suitably spaced parallel arms 19, 20, and 21, 22, and the piston rod 14 extends through the space between the pairs of parallel arms. By virtue of this construction and the location of the cross heads 16 in the guides 17 and 18 any lateral strain upon the piston rods is avoided. Links 23 and 24, which are mounted upon the wrist pin 15, extend respectively between the arms 19—20 and 21—22 of the rock shaft and are pivotally connected thereto by pins 25 and 26.

Suitable means are provided for simultaneously forcing liquid, preferably oil, under pressure to like chambers of the respective cylinders. In the preferred construction illustrated such means comprises a gear pump 27 which is located preferably approximately midway of the length of the grapple and a conduit 28 leads therefrom to a pipe having branches 29 and 30 communicating with the end chambers of the respective cylinders 12 and 13. Similarly a conduit 31 leading from the opposite side of the gear pump 27 communicates with branch pipes 32 and 33 leading to the inner chambers of the respective cylinders 12 and 13 as shown in detail in Fig. 3.

A suitable motor preferably a reversible electric motor 34, which is mounted upon the frame, is employed to drive the gear pump 27 and desirably an electrically operated brake 35 is interposed between the motor and the pump and is adapted to apply frictional pressure to a drum upon the motor shaft to overcome the momentum of the motor and other parts when the electric current to the motor is discontinued. This brake mechanism may be of any usual character and need not be described.

In the operation of the machine when the armature motor 34 is rotated in one direction the gear pump is actuated to supply liquid under pressure through the conduit 28 and the branches 29 and 30 thereof to the outer chambers of the respective cylinders 12 and 13 thereby forcing the piston toward the inner end of the cylinders and causing the piston rods to move the cross heads outwardly.

Inasmuch as the capacity of the outer chambers of the cylinders 12 and 13 is greater than that of the inner chambers of the cylinders, because of the presence of the piston rod in the latter, means are provided for supplying a supplemental amount of liquid to the conduit leading to the outer chambers of the respective cylinders. This is accomplished in the present invention by providing a closed tank 36 partially filled with oil which communicates with the conduit 31, or as illustrated in Fig. 3, with the branch 33 leading therefrom.

Desirably also a similar supplemental closed tank 37 partially filled with liquid communicates with the conduit 28 leading from the opposite side of the pump 27, or as illustrated in Fig. 3, with the branch 30 leading from the conduit. Both of these tanks are mounted above the level of the pump so that liquid will flow freely to the pump and prevent it from becoming "air bound," and will insure uniform circulation of the liquid

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through the pump during the operation of the device.

In the operation of the device the armature of the motor 34 is rotated in a direction to cause the gear pump 27 to force liquid under pressure through the conduit 28 and the branch pipes 29 and 30 to the outer ends of the cylinders. The pistons 14 thereof will be forced toward the inner end of the cylinder thereby causing the links 23 and 24, which connect the wrist pins 15 to the shafts 25 and 26 at the upper ends of the parallel arms 19—20, 21—22 respectively, to rotate the rock shafts 4 and 5 in a direction to cause the pointed ends 7 and 10 of the grapple to penetrate the material which is to be transported.

During such rotation of the gear pump the liquid will be exhausted by the pump 27 from the inner chambers of the cylinders 12 and 13. Upon reversal of the direction of rotation of the armature of the motor 34 fluid under pressure will be forced through the conduit 31 and the branches 32 and 33 to the inner chambers of the respective cylinders, thereby forcing the pistons and piston rods thereof in the opposite direction and causing the links 23 and 24 to move the pairs of arms of the shafts 4 and 5 in a direction to swing the tines of the grapple fork outwardly and thereby disengage them from the material to be transported.

A suitable manually controlled reversing switch, preferably located in the cab of the traveling crane which has the hoisting mechanism for raising and lowering the grapple such as illustrated in my co-pending application, is provided for controlling the direction of flow of the electric current to the reversible motor and as conventionally illustrated in Fig. 1 has a reversing switch 38.

Desirably suitable means are provided for breaking the electric circuit leading to the motor when the tines of the forks have approximately reached the limit of their swinging movement. In the particular construction illustrated switch boxes 39 and 40 are mounted upon one end of the frame and the switches thereof are provided with downwardly extending arms 41 and 42 which are connected by a coiled spring 43 and are provided at their lower ends respectively with rollers adapted to be respectively engaged by arms 44 and 45 which are adjustably mounted upon a sliding bar 46 which is mounted in the slotted ends of guides 47 and 48. The sliding bar 45 is provided with an offset rectangularly recessed portion 49 which is engaged by a cam-like projection 50 upon the end hub 3 of the end tine 6 as shown in Fig. 1. When therefore the rock shaft 4 approaches the limit of its movement swinging the arms of the grapple inwardly the roller of the arm 42 will be engaged by the arm 45 on the bar 46 and swing it in a direction to cause the stop switch to break the electric circuit. This switch also controls means not shown for causing the brake to be applied to the motor shaft thereby to arrest the inward swinging movement of the tines. Conversely when upon reversal of the motor the tines are swung away from each other the arm 44 will engage the roller upon the end of the arm 41 and move it in a direction to cause the switch 39 to break the electric circuit to the motor as the tines are swung to the outer limit of their movement and similarly apply the electric brake to the motor shaft.

In order to insure proper co-ordination of the swinging movement of the respective series of tines suitable means are provided for connecting the ends of the rock shafts 4 and 5. In the con-

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struction illustrated the shafts 4 and 5 project beyond the ends of the frame and are provided with sprockets 51 and 52 and a crossed chain 53, which is mounted upon the sprockets 51 and 52, is provided with a centrally slotted link 54 through which the crossing strand of the chain extends, the slot in the link 54 being of sufficient length to permit the rocking of the respective shafts without engaging either of the sprockets 51 and 52.

By virtue of the construction above described a balanced grapple is provided of a very powerful character and which can be easily and readily controlled.

It will be understood that the embodiment of the invention shown and described herein is of an illustrative character and that various modifications in construction and arrangement of parts may be made within the spirit and scope of the following claims.

Having thus described the invention, what is claimed as new, and desired to be secured by Letters Patent, is:

1. A vertically movable grapple fork comprising a frame, parallel rock shafts mounted thereon each having rigid therewith a series of hooked tines complementary to those of the other, and reversely arranged simultaneously operated power applying units mounted on and connected directly and separately each to its respective rock shaft and acting simultaneously to swing said tines toward and from each other.

2. A vertically movable grapple fork comprising a frame, parallel rock shafts mounted thereon each having rigid therewith a series of hooked tines complementary to those of the other, reversely arranged simultaneously operated power applying units mounted on opposite end portions of said frame for actuating the respective shafts to swing said tines toward and from each other, and means engaging like ends of both shafts for coordinating the swinging movements of the respective tines.

3. A vertically movable grapple fork comprising a frame, parallel rock shafts mounted thereon each having rigid therewith a series of hooked tines complementary to those of the other, reversely arranged simultaneously operated power applying units mounted on opposite end portions of said frame for actuating the respective shafts to swing said tines toward and from each other, complementary sprockets upon said shaft, a crossed chain engaging said sprockets, one of the leads of said chain having a longitudinal slot therein and the other lead passing through said slot, the slot being of sufficient length to permit such rotation of the respective shafts as to coordinate the swinging movements of the respective tines.

4. A vertically movable grapple fork comprising a frame, parallel rock shafts mounted thereon each having rigid therewith a series of hooked tines complementary to those of the other, fluid operated means mounted on opposite end portions of said frame having means for rotating the respective shafts to swing said tines toward and from each other, comprising liquid circulating means for supplying fluid under pressure simultaneously to both of said fluid operated means and conversely withdrawing the fluid therefrom in such manner as to move said tines toward and from each other.

5. A vertically movable grapple fork comprising a frame, parallel rock shafts mounted thereon each having rigid therewith a series of hooked tines complementary to those of the other, re-

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versely arranged hydraulic cylinders mounted on opposite end portions of said frame having pistons, and means operable by the reciprocation of the respective pistons to rotate the respective shafts in directions to swing the tines toward and from each other, liquid circulating means having means for simultaneously supplying liquid under pressure to the outer chambers of the respective cylinders and for simultaneously withdrawing liquid from the inner chambers of the respective cylinders to swing the tines toward each other and means for reversing the flow of liquid to swing said tines away from each other.

6. A vertically movable grapple fork comprising a frame, parallel rock shafts mounted thereon each having rigid therewith a series of hooked tines complementary to those of the other, reversely arranged hydraulic cylinders mounted on opposite end portions of said frame having pistons, and means operable by the reciprocation of the respective pistons to rotate the respective shafts in directions to swing the tines toward and from each other, a rotary pump having conduits for simultaneously supplying liquid under pressure to the outer chambers of the respective cylinders and for simultaneously exhausting liquid from the inner chambers of the respective cylinders to swing the tines toward each other and for reversing the flow of liquid to swing said tines away from each other, a reversible electric motor for actuating said pump, and reversible means for controlling the current supplied to said motor.

7. A vertically movable grapple fork comprising a frame, parallel rock shafts mounted on and extending longitudinally of said frame each having rigid therewith a series of downwardly extending hooked tines and each having an upwardly extending crank arm at the opposite end from that of the other, reversely arranged hydraulic cylinders mounted upon diagonally opposite end portions of said frame each provided with a piston having a piston rod linked to the adjacent arm of the rock shaft, a rotary pump for supplying liquid to the respective cylinders having a conduit provided with branches leading to the outer chambers of the respective cylinders, and a complementary conduit having branches leading to the inner chambers of the respective cylinders, a reversible electric motor for actuating said pump selectively to supply liquid under pressure to the outer cylinders or to the inner cylinders, and manually operable means for controlling the direction of flow of the electric current to said motor.

8. A vertically movable grapple fork comprising a frame, parallel rock shafts mounted on and extending longitudinally of said frame each having rigid therewith a series of downwardly extending hooked tines and each having an upwardly extending crank arm at the opposite end from that of the other, reversely arranged hydraulic cylinders mounted upon diagonally opposite end portions of said frame each provided with a piston having a piston rod linked to the adjacent arm of the rock shaft, a rotary pump for supplying liquid to the respective cylinders having a conduit provided with branches leading to the outer chambers of the respective cylinders, and a complementary conduit having branches leading to the inner chambers of the respective cylinders, a reversible electric motor for actuating said pump, a circuit for supplying an electric current to said motor having therein a stop switch mechanism, means including a cam on one of

said shafts for actuating said stop switch mechanism to break the electric circuit upon predetermined completion of the swinging movement of the tines in each direction, and manually operable means for controlling the direction of flow of the electric current to said motor.

9. A vertically movable grapple fork comprising a frame, parallel rock shafts mounted on and extending longitudinally of said frame each having rigid therewith a series of downwardly extending hooked tines and each having upwardly extending crank arms at the opposite end from that of the other, reversely arranged hydraulic cylinders mounted upon diagonally opposite end portions of said frame each provided with a piston having a piston rod linked to the adjacent arms of the rock shaft, a rotary pump for supplying liquid to the respective cylinders having a conduit provided with branches leading to the outer chambers of the respective cylinders, and a complementary conduit having branches leading to the inner chambers of the respective cylinders, a closed tank partially filled with liquid communicating with the conduit leading to the inner chamber of the respective cylinders operable to supply additional liquid to the pump to supplement the amount of liquid exhausted from the inner chamber of said cylinders which is of less capacity, a reversible electric motor for actuating said pump, and manually operable means for controlling the direction of flow of the electric current to said motor.

10. A vertically movable grapple fork comprising a frame, parallel rock shafts mounted on and extending longitudinally of said frame each having rigid therewith a series of downwardly extending hooked tines and each having an upwardly extending crank arm at the opposite end from that of the other, reversely arranged hydraulic cylinders mounted upon diagonally opposite end portions of said frame each provided with a piston having a piston rod linked to the

adjacent arms of the rock shaft, a rotary pump for supplying liquid to the respective cylinders having a conduit provided with branches leading to the outer chambers of the respective cylinders, and a complementary conduit having branches leading to the inner chambers of the respective cylinders, closed tanks partially filled with liquid communicating with the respective conduits leading to the outer and inner chambers of the respective cylinders operable to insure a proper circulation of liquid through said pump to the respective chambers of the cylinders irrespective of the direction of rotation of the pump, and manually operable means for controlling the direction of flow of the electric current to said motor.

11. A vertically movable grapple fork comprising a frame, parallel rock shafts mounted on and extending longitudinally of the sides of said frame each having rigid therewith a series of downwardly extending hooked tines complementary to those of the other, suitably spaced pairs of parallel crank arms rigid with and extending upwardly from opposite ends of the respective shafts, reversely arranged hydraulic cylinders transversely mounted on opposite end portions of said frame each provided with a piston having a piston rod extending between the pairs of parallel arms of its rock shaft, a wrist pin connecting the end portion of said piston rod to a cross head slidably mounted in guideways, and parallel links connecting said wrist pin to the respective pairs of parallel arms of said rock shaft, and a manually controlled electrically operated reverse pump for supplying liquid under pressure simultaneously to the outer chambers of the respective cylinders and for exhausting the fluid from the inner chambers of said cylinders to swing the tines toward each other and upon reversal of said pump to swing the tines away from each other.

ARTHUR M. STEVENS.