

Aug. 16, 1966

A. R. JOHNSON

3,266,801

FLUID-OPERATED ROWING MACHINE

Filed Oct. 26, 1964

3 Sheets-Sheet 1

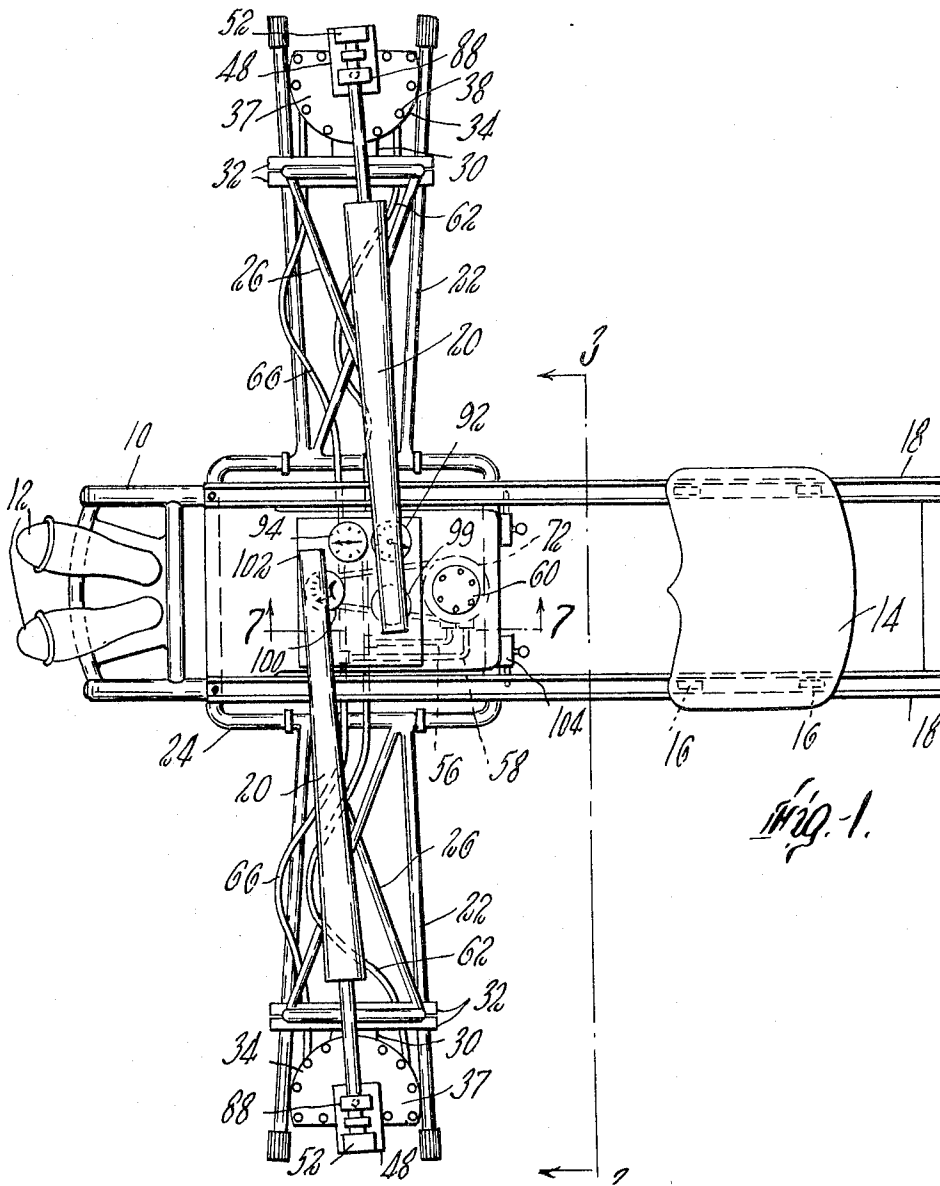


Fig. 1.

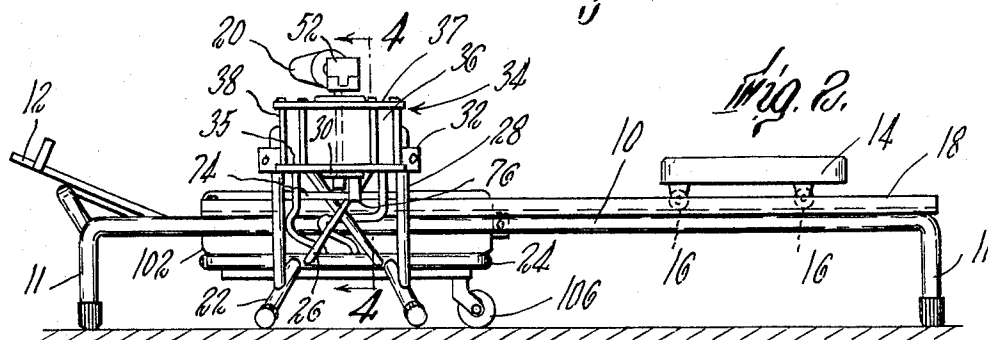


Fig. 2.

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3 Sheets-Sheet 2

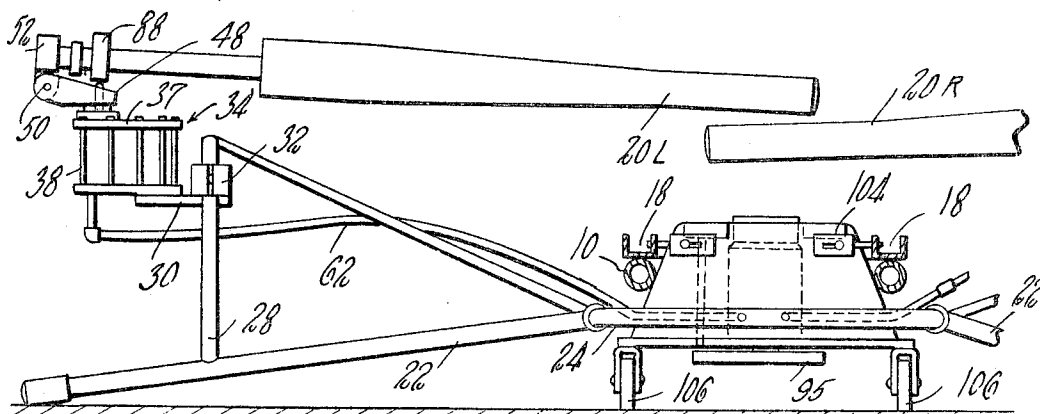
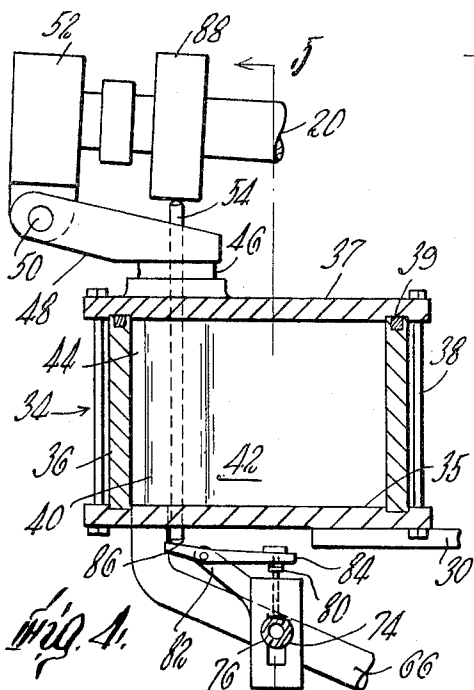


Fig. 3.

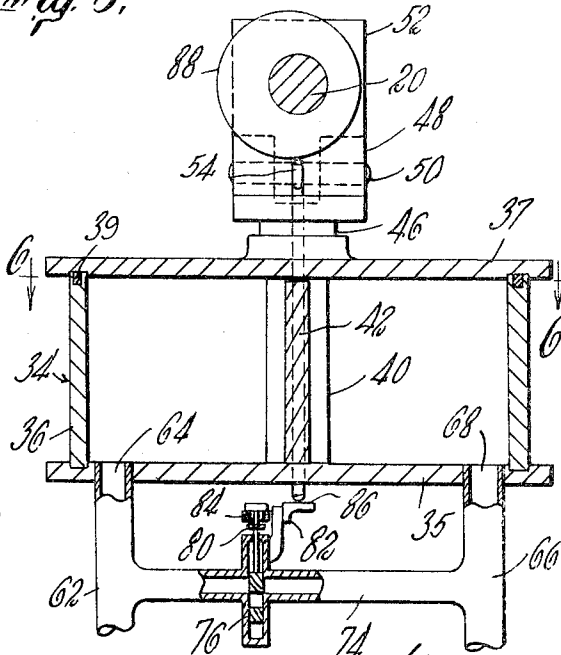


Fig. 4.

Fig. 5.

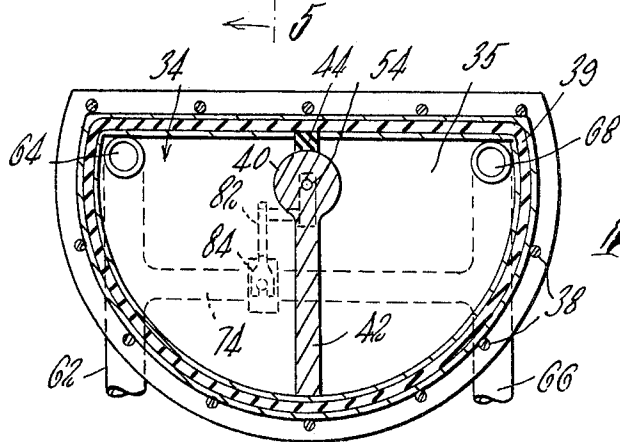


Fig. 6.

Aug. 16, 1966

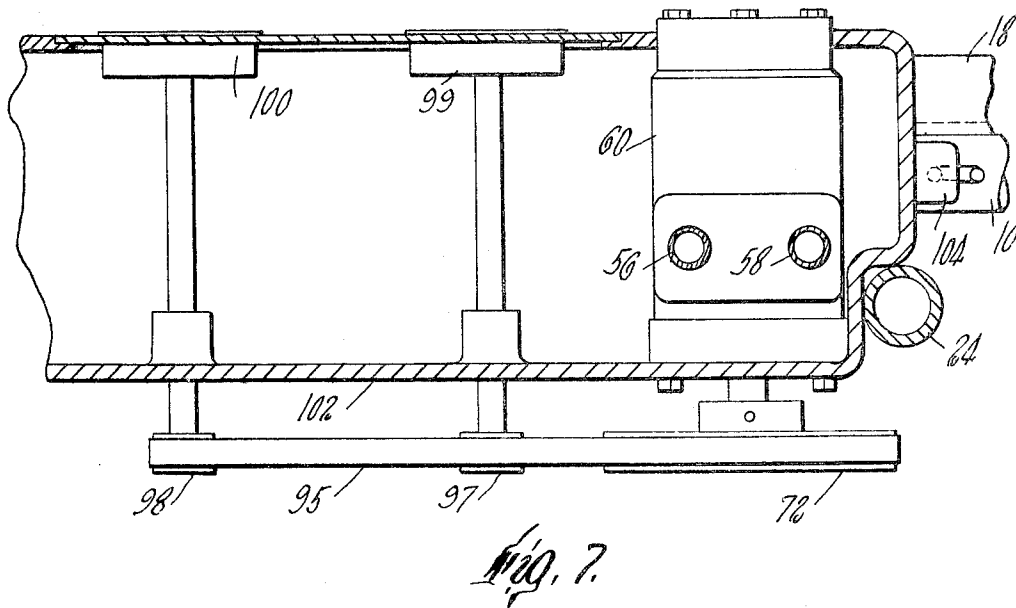
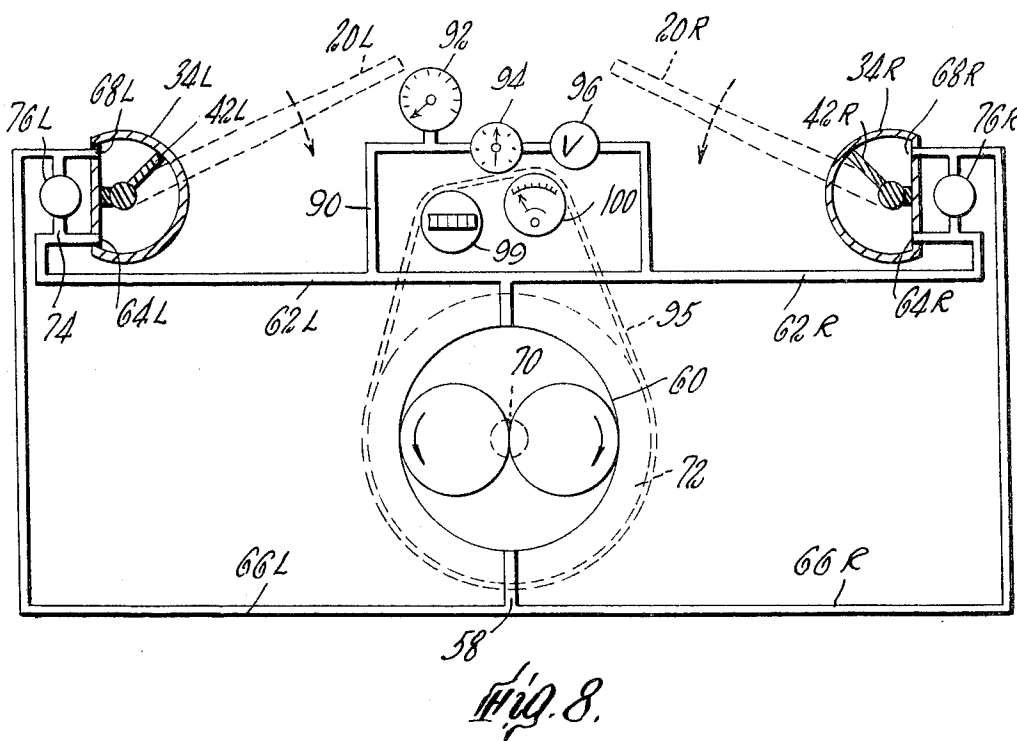
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Filed Oct. 26, 1964

3 Sheets-Sheet 3



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FLUID OPERATED ROWING MACHINE

Avery R. Johnson, Boston, Mass., assignor to Bio-Dynamics Incorporated, Cambridge, Mass., a corporation of Massachusetts

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9 Claims. (Cl. 272-72)

This invention relates to what are called "rowing machines," which are athletic exercise or practice devices in the form of equipment with "oars," used by a person in imitating the actions of rowing a boat. More particularly the invention relates to a portable rowing machine that is used on dry land or in the absence of water as distinguished from those that require a pool, tank or other body of water for their use.

Portable rowing machines of this general type are well known, but previous devices fail to furnish certain action and reaction forces encountered in the actual rowing of a boat in water and therefore do not truly simulate the natural rowing effort and effect to a person using the machine.

The principal object of this invention therefore, is to provide a rowing machine having action and reaction characteristics and forces closely approximating those found in manipulating the oars of a boat in water so that use of the machine as an exerciser truly simulates the rowing effort of a person in a rowboat and the effect of the moving water on the oars.

Many prior rowing machines function strictly as exercising devices, such devices lacking any means for gauging the effort expended or the results accomplished in using them. Another object of the present invention is to provide, in a portable rowing machine of the type here involved, means including indicators to show the amount and "direction" of force being exerted by the operator and the "speed" and/or "distance" attained by him when using the device. In this way the machine may be used to measure and compare the effectiveness of a single operator at different times, or as a competitive device to measure and judge the superiority of one contestant over another when using the machine.

The principal object of the invention is met by providing a rowing machine with "oars," the movements of which are reflected by hydraulic piston elements acting at the ends of the loops of a symmetrical closed double loop fluid-filled hydraulic system, this system having at its center, common to both loops, a fluid motor-pump device that drives a flywheel. Operation of the piston elements by a stroke of the oars starts circulation of hydraulic fluid in both loops of the system and through the centrally located motor device to drive the flywheel. The inertia of the rotating flywheel causes the motor-pump device to act as a pump and continue circulation of the fluid in both loops of the hydraulic system, applying pressure against the reverse sides of the piston elements. Thus, after a stroke of the oars, fluid pressure will be brought to bear on the oars much as it would be in the case of an oar stroke in water, assuming that the handles of the oars are not depressed at the end of the stroke. A valved bypass is provided in the system for each oar so that when the hand grip of the oar is depressed, as it would be naturally at the end of the stroke to lift the oar out of the water, the valve in the bypass is opened, pressure of circulating fluid will not reach the piston element and the circulating hydraulic fluid will not influence the actuation of the oar. By this means, the natural reaction of an oar to water at the end of a stroke is preserved. Other valving means are provided for this bypass to open the same and relieve the piston element from the pressure of circulating fluid when the oar is twisted to a blade "feathering" position, and this valve

may be the same one that is opened upon depression of the hand grips of the oars.

The circulating hydraulic system and the motor-pump with flywheel characteristic of this invention include components uniquely adapted for the attachment of instruments for the measurement of force, balance or "direction," accumulated travel or "distance," and "speed." According to another aspect of this invention, performance measuring devices for indicating the force exerted and the "direction" or balance of pull between the oars are provided by hydraulically actuated instruments located in a common fluid line bypassing the motor-pump and connected to corresponding points in the two closed loops of the system. Instruments for indicating "distance" and "speed" are of mechanical types, driven by a rotating element on the motor-pump, for example, by the flywheel.

Other objects and further details of that which is believed to be novel and included in this invention will be clear from the following description and claims, taken with the accompanying drawing in which is illustrated an example of rowing machine embodying the present invention and incorporating the motor-pump with flywheel at the center of the symmetrical closed double loop hydraulic system and the performance measuring instruments as above generally described.

In the drawing:

FIG. 1 is a top plan view of a rowing machine according to the invention showing the general organization of parts;

FIG. 2 is a left-side elevational view of the same;

FIG. 3 is a vertical transverse view through one side of the machine substantially on the line and in the direction of the arrows 3-3 of FIG. 1;

FIG. 4 is an enlarged vertical transverse section through one of the piston chamber elements of the machine, substantially on the line and in the direction of the arrows 4-4 of FIG. 2;

FIG. 5 is a vertical sectional view at right angles to FIG. 4 substantially on the line 5-5 thereof;

FIG. 6 is a horizontal sectional view on the line 6-6 of FIG. 5;

FIG. 7 is an enlarged vertical longitudinal section, substantially on the line and in the direction of the arrows 7-7 of FIG. 1, and

FIG. 8 is a diagrammatic view of the hydraulic system and principal associated elements of apparatus according to this invention.

In the embodiment of the invention here shown, there is a tubular metal supporting frame or base 10, having legs 11 and carrying foot rests 12. A seat 14 carrying rollers 16 is mounted to ride in tracks 18 secured to the frame. Such things are common in rowing machines and need not be described in detail. "Oars" of a usual type 20 also are provided, but the mounting and connecting of these oars in the apparatus constitutes a departure from prior practices that is germane to the present invention. Because both sides of the machine are identical, although in reverse positions, the same reference numerals will be used herein for the parts on each side, with the addition of the letter L for "left" and R for "right" whenever parts on the left or on the right side of the machine are distinguished from one another.

Accordingly, the outer end of each oar is supported generally from the frame or base as by an outrigger 22 which is fastened to a central auxiliary frame 24 carried between the sides of the main frame in any suitable fashion. Cross struts 26 and uprights 28, attached to each other and to the auxiliary frame and outriggers, provide a stable anchorage for an oar mount supporting plate 30 on each side of the machine, outboard of the central main and auxiliary frames. The oar mount plates 30 may be ad-

justably secured on the uprights 28 and fixed at a desired level as by the clamping bars 32 or something similar. The ends of the legs and of the outriggers may be provided with cushioned friction tips, as shown, to prevent the machine from sliding on or marring the floor when in use.

Supported by each of the oar mount plates 30 is a piston receiving chamber 34, shown here as of upright semi-cylindrical form, having a bottom wall 35 suitably secured on the mounting plate, upright walls 36 and a top wall 37. Bolts 38 extending between the top and bottom walls may hold these together against the upright walls, the entire chamber being made fluid-tight at its joints between the walls as by gaskets 39 or other sealing arrangements.

The piston element in each chamber is of the swinging blade or wing type, pivoted vertically on an axis opposite the center of the straight upright wall portion of the piston chamber and having a cylindrical portion 40 with a flat rectangular blade or wing portion 42 extending therefrom into close sliding contact with the flat top and bottom and curved upright walls of the chamber. The top end of the cylindrical portion passes in rotatable sealed relation through the top chamber wall 37, while the bottom of the piston is pivoted although sealed in the bottom wall 35. A sealing strip 44 is provided inside the piston chamber alongside the cylindrical portion 40 to seal one side of the piston from the other adjacent its pivot and furnish separate compartments in the chamber, variable in size depending upon the piston blade position.

An extension or collar 46 on the outside of the cylindrical portion of the piston carries an offset oar pivot bracket 48 with a horizontal pivot pin 50 offset outwardly of the vertical pivot axis of the cylindrical portion 40. The bracket 48 acts as a crank arm to swing the piston blade 42 about the vertical axis of its cylindrical portion 40. The pivot pin 50 carries an oar lock simulating cylindrical socket 52 with a central pivotal axis at right angles to the pivot pin 50, in which oar lock socket the outer end of an "oar" 20 is journaled in any suitable fashion.

With the above arrangement, it will be seen that, as either oar is stroked or moved backward or forward from a given position the blade of its piston will swing about a vertical axis through a corresponding angle and direction in the piston chamber, and the oar may be raised or lowered and twisted about its own axis in one direction or the other during this stroking of the oar or without stroking the oar. The vertical pivot of the piston element allows the forward and backward oar movement, the horizontal pivot pin allows the upward or downward movement and the axial pivot mounting of the oar in the socket 52 permits rotation of the oar or twisting about its own axis. For purposes that will later appear, a readily visible mark or projection (not shown) is preferably provided on each oar to indicate its rotative position when the "blade" of the oar would be in proper vertical position for stroking or in horizontal position for "feathering," as if the oar did have a true blade. To conserve space, the oars of rowing machines are not usually provided with true blades.

Means are provided whereby the action of the rowing machine is altered depending upon the rotative position of the oar about its axis, or the raising and lowering of the inner end or hand grip of the oar, but because this involves the entire hydraulic system it will be explained more fully at a later point. However, it will be noted that at the center of the vertical axis of rotation of the piston blade there is slidably mounted a valve control rod 54 which extends through the cylindrical portion 40 of the piston and projects at its top end above the oar pivot bracket 48 and at its bottom end below the bottom wall 35 of the piston chamber.

The hydraulic piping system characteristic of this invention is composed essentially of two identical closed

loops symmetrically arranged and each connected to a motor-pump 60 through a common central connection or inlet 56 and a common central connection or outlet 58. Connection 56 leads to identical sections 62L and 62R of the hydraulic system on either side of the machine. Each of these terminates at its outer end in an opening 64 in the piston chamber 34 in the compartment on one side of the piston blade 42. Completing the identical and symmetrical loops of the hydraulic system on either side of the machine, sections 66L and 66R, equal in capacity to the sections 62, lead from the common connection 58 to openings 68L and 68R respectively in the piston chamber compartments on the opposite sides of the piston blades 42.

Ignoring the reaction controls of this invention for the moment, when an operator pulls an oar 20 in a stroke, the corresponding piston blade 42 will swing in the chamber 34 and produce pressure and flow of the liquid in the system through the opening 64 of the piston chamber, to the section 62L or 62R of the system, and from the connection 56 into the motor-pump device 60. This will operate the device 60 as a motor and drive the rotating shaft 70, on which a flywheel 72 is suitably secured.

The motor-pump 60 is a type of rotary fluid-pressure operated motor device. Many such devices, when the motor is rotatably driven by an outside force, will act in an opposite manner as a pump for the fluid contained therein. One fluid motor-pump of this kind found particularly useful in the apparatus of the present invention is disclosed in United States Patent No. 2,821,171 issued January 28, 1958 to Lynn L. Charlson, reissued as No. Re. 25,291, December 4, 1962. Other fluid motor-pumps, such as one of the well known gear or turbine fluid pumps, might be used with this invention if it exhibits the desired reversible performance characteristics. In other words, the device must be capable of performing as a fluid-driven motor to drive the shaft 70 and flywheel 72 when proper fluid pressure is applied at the hydraulic inlet 56. However, the device must also act in an opposite sense as a mechanically driven pump to produce fluid pressure in the hydraulic outlet 58 and flow of fluid when outside mechanical force rotates the shaft 70. The inertia of rotating flywheel 72 provides the necessary outside driving force.

As the hydraulic fluid in the system passes through the motor, it leaves by the connection 58 and continues through the sections 66L and 66R of the loops on either side of the machine, passing therefrom through the openings 68 of the piston chambers, thereby producing pressure in a compartment of the piston chambers against the reverse sides of the piston blades 42. At the end of the stroke, if the operator does not manipulate the oars properly, the inertia of the spinning flywheel will cause a continued fluid pressure in the system to tend to hold the oar on either side of the machine at its end-of-stroke position for as long as the flywheel rotates, the device 60 acting as a pump at this time, to keep the fluid under pressure in the hydraulic system.

In order to provide a means whereby the oars may be returned by an operator at the end of a stroke without the opposition of liquid pressure in the system, a return bypass 74 is provided on each side of the machine extending between the pipe sections 62 and 66 close to the openings 64 and 68 in each chamber 34. Each return bypass in the system is opened or closed by a valve 76, shown best in FIGS. 4 and 5, the details of which are not particularly important as long as the valve will operate in the manner about to be described. In the form illustrated, the valve includes a spring (not shown) that tends to hold the valve stem 80 and valve 76 in a position so that bypass 74 is blocked. Outside of the valve body a pivoted crank arm 82 is mounted in such position that its forked end 84 extends under and in contact with the head of the valve stem while the other end has a bearing surface 86 extending under and in contact with the bottom end of the valve control rod 54 previously mentioned. It

5

will be seen that when the rod 54 is depressed it lowers the end 86 of the crank arm 82 and raises the end 84, lifting the valve stem 80 against the bias of the valve spring and opening valve 76 so that the bypass 74 is free for circulation of fluid directly from section 66 to section 62, without the fluid applying pressure in the piston chamber 34. When the inner ends or hand grips of the oars are properly lowered at the end of a stroke, this is the position of parts and the condition of the hydraulic system desired, the device 60 operating as a pump to produce circulation of hydraulic fluid from sections 66 to sections 62 in the system under the influence of the spinning flywheel.

In order to control this bypass valve and actuate it as desired when the oar handle is properly manipulated by the operator, a valve control cam 88 is provided on each oar at a position on the oar always located immediately above the top end of the control rod 54. This cam is provided with outer surfaces for engagement with and depression of the valve control rod whenever the hand grip of the oar is depressed beyond a certain point, as it would be when naturally making a return stroke in rowing, and raised surfaces on the cam are also arranged to depress the valve control rod whenever an oar is twisted about its axis to an angular position in which the oar would be "feathered."

Thus the action of the machine and the reaction forces produced will imitate closely those encountered in actual rowing. A stroke of the oar when its hand grip is raised and the oar is not "feathered" will start circulation of fluid in the system, and this circulation will produce back pressure on the piston and on the oar until the inner end or hand grip is lowered or the oar is twisted to feathered position. A return swing of the hand grip to starting position can then be made without resistance of the pressure of fluid circulating in the system. However, when the oars are again "dipped," as by raising the hand grips, and a new stroke is started, the influence of the liquid moving in the system will be felt on the blades of the pistons, imitating the reaction of moving water that would be encountered by an oar in a boat when used in its natural environment. If an oar is not feathered, or if its handle is not properly lowered as it should be on a return stroke, the liquid flowing in the system under the impetus of the spinning flywheel will oppose the return stroke of that oar much as moving water would oppose a return oar stroke under like conditions.

Note that if the motor-pump is of a reversible flow type, the machine will work equally well in simulating back-paddling or reverse rowing. In this case the machine may be used not only as an exerciser but also as a training device to familiarize a beginner with the proper way to manipulate a pair of oars when handling a row boat. Maneuvering of a boat therefore may be learned on this machine by experience without going near a body of water.

A rowing machine with the action and reaction arrangements as above described lends itself peculiarly to the addition of applied force measuring and performance accomplishment indicating instruments. For example, at identically spaced points on either side of the connection 56 in the sections 62L and 62R of the hydraulic system, a bypass loop 90 is connected, and in this loop a fluid pressure gauge 92 of conventional design may be connected. This gauge, being open to the influence of pressure from both sides of the system, will measure the net pressure or force produced in the system by an operator during each stroke. Gauge 92 may be calibrated in pounds per square inch. If the user of the equipment is pulling harder on one oar than on the other, this will produce a greater pressure in one of the lines 62 than in the other, and this difference in pressure between the two sides of the system may be measured and indicated by a differential flow indicating gauge 94 in the bypass loop

6

90, this instrument being conveniently calibrated in points of the compass if desired, to indicate the "bearing" of the operator using the machine. When these measurements are not deemed of importance, the bypass 90 may be effectively closed off from the system by an appropriate hand valve 96.

Because the rotary shaft 70 of the motor-pump and the flywheel thereon are driven at rates directly proportional to movement of fluid in the hydraulic system, these rotating parts in turn may be used to drive instruments for measuring other work being done by the machine. Accordingly, the flywheel may be provided with a driving belt or chain 95 which extends around driving wheels or gears 97 and 98 for an odometer 99 and a tachometer 100 respectively which may indicate "distance" and "speed" inappropriate nautical units.

As shown, each of the gauges or instruments 92, 94, 99 and 100 may be suitably mounted and supported in a housing 102 carried in the auxiliary frame 24 in a position in front of the rower, so that he may observe his performance and vary his efforts in the manner he chooses. The motor-pump 60 and flywheel also are conveniently supported and carried in this housing so that the assembly may be maintained in a compact area.

Although the connections 56 and 58 of the hydraulic system piping may be made of rigid tubing, the major portions of sections 62 and 66 on either side of the machine are preferably of a flexible type, at least up to the return bypass sections 74L and 74R. These sections, of course, should be rigid and mounted in a fixed position relative to the piston chambers so that the valve assemblies 76 therein are properly held in fixed position for operation by the control rods 54.

Flexible tubing for the major portion of the hydraulic system also makes it possible to connect the out triggers to the sides of the auxiliary frame in a pivotal fashion so that these sidewise extending members may be folded upwardly toward one another. The auxiliary frame also may be detachably secured to the main frame as by sliding bolt connections 104. When the main frame is disconnected and removed from the auxiliary frame and the outriggers are folded over the auxiliary frame, casters 106 on the housing 102 may be used to roll the auxiliary frame about from place to place, the auxiliary frame with the collapsed outriggers serving as a wheeled carrier for the detached main frame and other attachments. With such arrangements the machine will occupy but a small area when not in use, and it may be moved readily from place to place.

Although a preferred form of rowing machine has been described in the foregoing, certain aspects of this invention are not limited to the particular details of apparatus set forth as an example, and it is contemplated that various and other modifications and applications of the invention will occur to those skilled in the art. It is therefore intended that the appended claims shall cover such modifications and applications as do not depart from the true spirit and scope of the invention.

What is claimed as new and is desired to be secured by Letters Patent of the United States is:

1. In a rowing machine of the character having an oar simulating element with a hand grip portion at one end and means mounting said oar element at its other end to swing about a vertical axis to simulate oar stroke movement in one direction and oar return movement in the reverse direction; and to pivot about a horizontal axis to simulate oar dipping position when said hand grip portion is raised and oar lifting position when lowered, that improvement comprising

a closed circuit, fluid-filled hydraulic piping system, a piston in said system actuated by said oar element for initiating fluid flow and circulation in said system when said oar hand grip is in oar dipping position and is swung about its said vertical axis in a direction to simulate an oar stroke movement,

fluid driven inertia means in said system sustaining fluid flow and circulation in said system when once initiated by said piston, said means continuing to apply fluid pressure in said system through said piston against said oar element in oar stroke movement direction when said hand grip portion of said oar is in raised oar dipping simulating position, and a bypass in said hydraulic system around said piston, including a normally closed valve, means for opening said valve actuated by said oar element when said hand grip portion thereof is in lowered pivoted oar lifting position about its horizontal axis, the opening of said valve relieving said oar element from fluid pressure applied by said inertia means through said piston, whereby when said bypass valve is opened by lowering said hand grip to simulate oar lifting position said oar element may be swung freely in the reverse direction about its vertical axis as when simulating oar return movement.

2. In a rowing machine of the character having an elongated oar simulating element with a hand grip portion at one end and means mounting said oar element at its other end to swing about a vertical axis to simulate oar stroke movement in one direction and oar return movement in the reverse direction; and to rotate about its own longitudinal axis substantially 90° from a normal blade position to simulate blade feathering position when said hand grip is twisted, that improvement comprising

a closed circuit, fluid-filled hydraulic piping system, a piston in said system actuated by said oar element for initiating fluid flow and circulation in said system when said oar hand grip is in normal blade position and is swung about its said vertical axis in a direction to simulate an oar stroke movement,

fluid driven inertia means in said system sustaining fluid flow and circulation in said system when once initiated by said piston, said means continuing to apply fluid pressure in said system through said piston against said oar element in oar stroke movement direction when said hand grip portion of said oar is in normal blade position,

a bypass in said hydraulic system around said piston, including a normally closed valve, means for opening said valve actuated by said oar element when said hand grip portion thereof is twisted about its own axis and rotated to blade feathering position at 90° from normal, the opening of said valve relieving said oar element from fluid pressure applied by said inertia means through said piston, whereby when said bypass valve is opened by rotating said hand grip to blade feathering position said oar element may be swung freely in the reverse direction about its vertical axis as when simulating oar return movement.

3. In a rowing machine of the character having an elongated oar simulating element with a hand grip portion at one end and means mounting said oar element at its other end to swing about a vertical axis to simulate oar stroke movement in one direction and oar return movement in the reverse direction; to pivot about a horizontal axis to simulate oar dipping position when said hand grip portion is raised and oar lifting position when lowered; and to rotate about its own longitudinal axis substantially 90° from a normal blade position to simulate a blade feathering position when said hand grip is twisted, that improvement comprising

a closed circuit, fluid-filled hydraulic piping system, a piston in said system actuated by said oar element for initiating fluid flow and circulation in said system when said oar hand grip is in normal blade and oar dipping positions and is swung about its vertical axis in a direction to simulate an oar stroke movement, fluid driven inertia means in said system sustaining fluid flow and circulation in said system when once initiated

ated by said piston, said means continuing to apply fluid pressure in said system through said piston against said oar element in oar stroke movement direction when said hand grip portion of said oar is in raised, oar dipping simulating position and in normal blade position,

a bypass in said hydraulic system around said piston, including a normally closed valve, means for opening said valve actuated by said oar element when said hand grip portion thereof is in lowered pivoted oar lifting position about its horizontal pivot axis, and means for opening said valve actuated by said oar element when said hand grip portion thereof is twisted about its own axis and rotated to blade feathering position at 90° from normal, the opening of said valve by either means relieving said oar element from fluid pressure applied by said inertia means through said piston, whereby when said bypass valve is opened by lowering said hand grip to simulate oar lifting position or by rotating said hand grip to blade feathering position, said oar element may be swung freely in the reverse direction about its vertical axis as when simulating oar return movement.

4. In a rowing machine of the type having a frame and a pair of oar simulating elements mounted pivotally with respect thereto at each side to swing back and forth about vertical axes at their outer ends, that improvement comprising

a pair of piston members each movable back and forth with a said oar element as said oar element swings about its vertical axis,

a cooperating piston chamber for each said piston member, in which chamber said member is movable back and forth,

a fluid filled hydraulic piping system comprising a pair of closed loops extending symmetrically on either side of said frame,

each said loop including a said piston chamber at its outer end, each said chamber being connected in its said loop by fluid openings on either side of its respective piston member,

a hydraulic motor-pump device centrally included in said piping system,

a fluid inlet connection and a fluid outlet connection on said device, each connection being common to both said loops of said system, said device being driven as a motor by passage of fluid therethrough from a said piston to said inlet and

a flywheel driven by said motor-pump device upon passage of fluid through said device and driving said device as a pump to circulate fluid from said common outlet through both loops of said system toward both said piston chambers and the pistons therein.

5. In a rowing machine of the type having a frame and a pair of oar simulating elements mounted pivotally with respect thereto at each side to swing back and forth about axes at their outer ends, that improvement comprising

a fluid filled hydraulic piping system comprising a pair of closed loops extending on either side of said frame,

a piston receiving chamber at each side of said frame, each chamber having spaced openings therein for the passage of fluid,

a cooperating swinging piston member in each chamber movable back and forth between said spaced openings in said chamber as a said oar element swings about its axis,

a rotary hydraulic motor-pump device having a fluid inlet and a fluid outlet, said device being driven by passage of fluid therethrough from said inlet to said outlet,

each of said loops including a first section leading from a said opening in a piston chamber to said motor-

pump fluid inlet, and a second section leading from said fluid outlet to the other said opening in said piston chamber,

whereby said fluid inlet and said fluid outlet on said motor-pump device are common to both said loops of said system, and each said piston chamber is connected in a said loop of said system, and

a flywheel rotatably driven by said motor-pump device upon passage of fluid from one said opening in a piston chamber through a said first section in a loop of said system to said common inlet and through said device, the inertia of said flywheel, when rotating, driving said device to pump fluid from said common outlet and circulate fluid through said second section in both loops of said system toward the other said spaced opening in both said piston chambers and the swinging piston members therein.

6. In a rowing machine of the character having a pair of oar simulating elements with hand grip portions at their inner ends and means mounting said oar elements at their outer ends to swing about axes to simulate oar stroke movement and oar lifting and feathering positions, that improvement comprising

a closed double loop, fluid-filled hydraulic piping system,

a piston in each loop of said system actuated by a said oar element for initiating fluid flow and circulation in said loop when said oar element is swung about its said axis to simulate an oar stroke movement,

fluid driven inertia means in said system common to both said loops sustaining fluid flow and circulation in said system when once initiated by a said piston, said means normally continuing to apply fluid pressure in both loops of said system through said pistons against said oar elements in oar stroke movement direction,

normally closed valve means in each said loop bypassing the respective pistons in the loops, and

mechanisms for opening said valve means and bypassing a said piston in a loop of said piping system, actuated by a said oar element when said element hand grip portion is positioned to simulate oar lifting and feathering.

7. An improved rowing machine according to claim 6, additionally comprising

a pipe section connecting together portions of the said loops in said piping system and

fluid pressure indicating instruments connected in said pipe section.

8. An improved rowing machine according to claim 6, additionally comprising

speed and distance indicators driven by said fluid driven inertia means.

9. An improved rowing machine according to claim 6, additionally comprising

a performance indicator mechanically driven by said fluid driven inertia means,

a pipe section common to each of the loops of said double loop hydraulic system, and

a hydraulic pressure indicator driven by fluid in said pipe section.

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RICHARD C. PINKHAM, *Primary Examiner*.

A. W. KRAMER, *Assistant Examiners*.