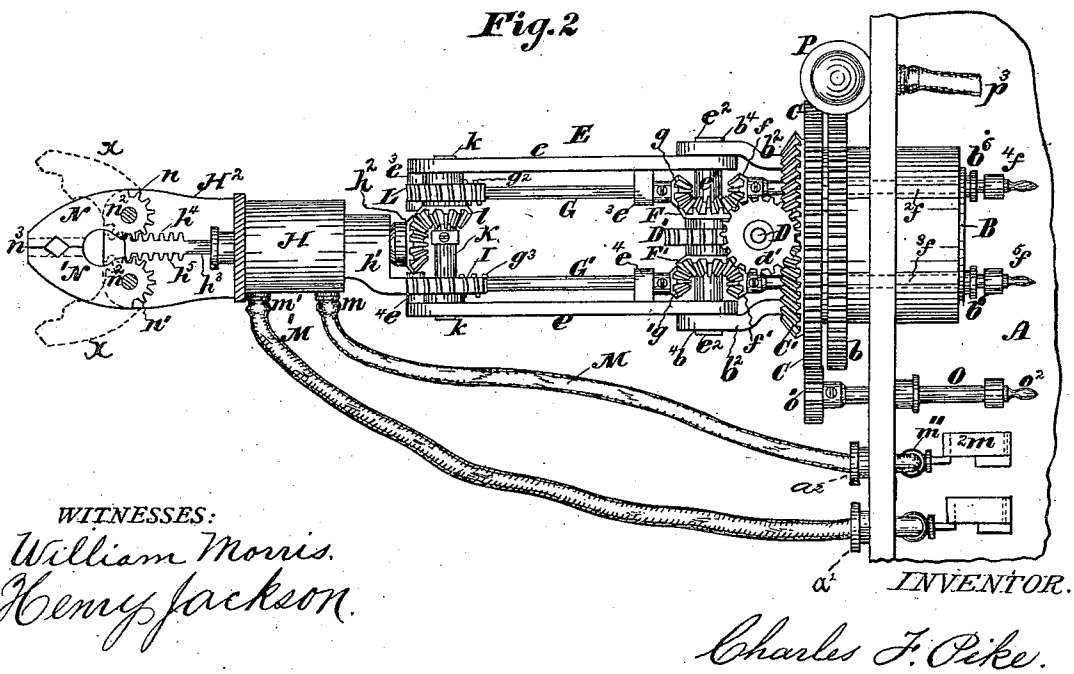
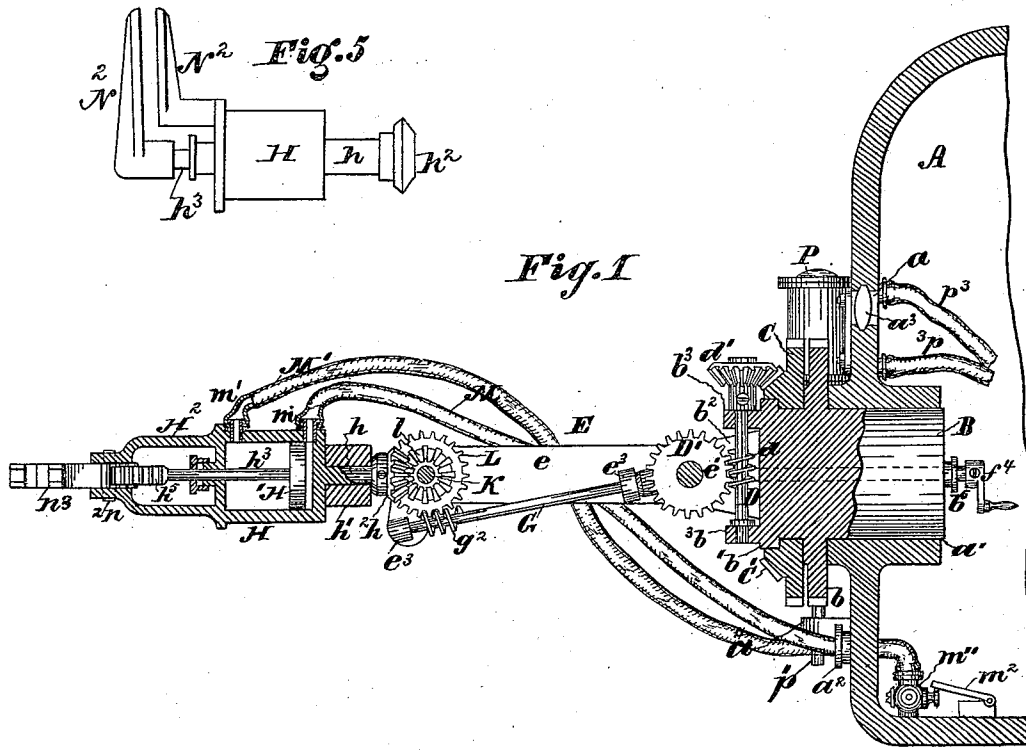


C. F. PIKE.

Arm and Attachments for Diving-Bells.

No. 228,556.

Patented June 8, 1880.



WITNESSES:

William Morris.
Henry Jackson.

INVENTOR.

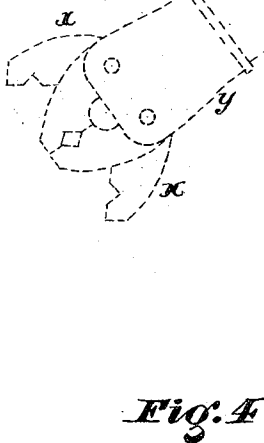
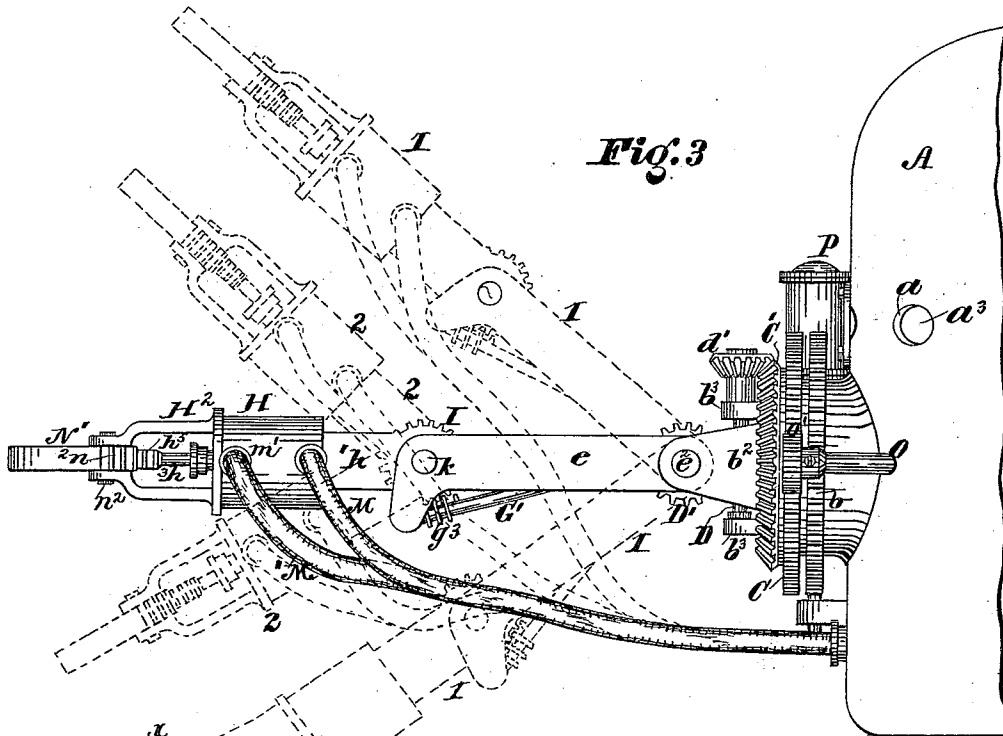
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UNITED STATES PATENT OFFICE.

CHARLES F. PIKE, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE
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ARM AND ATTACHMENT FOR DIVING-BELLS.

SPECIFICATION forming part of Letters Patent No. 228,556, dated June 8, 1880.

Application filed May 27, 1879.

To all whom it may concern:

Be it known that I, CHARLES F. PIKE, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Prosthetic Arms for Diving-Bells; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification, in which—

Figure 1 is a longitudinal vertical section of the arm and a broken section of the diving-bell. Fig. 2 is a plan of the same. Fig. 3 is a side elevation of the same, showing by dotted lines the various movements of parts of the apparatus. Fig. 4 is a transverse vertical section of the main shaft and front elevation of the rotating devices; and Fig. 5 is a modification of the jaws of the apparatus.

My invention has for its object to provide a diving bell or car, having exteriorly affixed thereto an improved prosthetic or mechanical arm or device constructed to rotate on its axis, while its individual component parts are free to move independently in many directions by the application of mechanism which is under the control of and operated by the diver within the bell or car.

My invention consists, primarily, in the provision of a prosthetic arm for a diving-bell provided with a pair of jaws which are opened and closed by means of atmospheric or hydraulic pressure controlled by the operator within the bell; second, in the provision of said jaws secured to a cylinder which is pivotally attached to a pivoted supporting-frame, upon the latter of which is secured and supported mechanism for oscillating said jaws and cylinder on the pivotal bearings of said cylinder and for rotating the same independently of said supporting-frame; third, in the provision of said jaws and cylinder with the supporting-frame, the latter being pivoted upon arms projecting from the main shaft or drum of the apparatus, and having a gear-connection therewith, and also with a gear-wheel placed upon a shaft which extends into the bell, by means of which said supporting-frame,

cylinder, and jaws are together simultaneously oscillated on the pivotal bearings of the said supporting-frame; fourth, in the provision of the main shaft or drum of the device, formed with a spur-wheel which meshes with a rack secured to a piston-rod which is operated by hydraulic or atmospheric pressure to rotate said drum and carry with it the supporting-frame, cylinder, and jaws, all of said parts being simultaneously rotated together; fifth, in the general combination, arrangement, and construction of parts, as hereinafter more particularly set forth.

Referring to the accompanying drawings, A designates a diving bell or car of any appropriate construction, having port-holes *a*, provided with glasses *a*³, to allow the operator stationed within said bell to see the object sought for and to observe in what manner the device is to be operated.

B is the main shaft or drum, passing through and revolving in an opening, *a*¹, in the side of the bell. Affixed to said drum or formed thereon is a gear-wheel, *b*.

C is another gear-wheel, placed loosely on said drum B, and is provided with a bevel-gear, C', both of which are held in position on said drum by its enlarged end *b*¹, and are free to revolve thereon. To said drum is secured, or may be formed integrally therewith, two projecting arms, *b*² *b*², and the journal-bearings *b*³ *b*³, for the reception of a shaft, D, upon which is formed a worm, *d*. Said shaft D is also provided at its upper end with a bevel-wheel, *d*¹, which meshes with the said bevel-wheel C', attached to the gear-wheel C.

E is a frame composed of two side bars, *e e*, and shafts *e*¹ and K. The shaft *e*¹ is firmly secured in the rear ends of the sides *e e*, as shown, and projects laterally a slight distance beyond said sides to form trunnions or pivotal bearings *e*² *e*², which enter openings *b*⁴ *b*⁴ in the arms *b*² *b*² of the drum B, thereby forming a connection therewith. Upon said shaft *e*¹ is rigidly secured the worm-wheel D', which meshes with the worm *d* upon the shaft D.

F and F' are bevel-wheels, also placed upon said shaft *e*¹, but are loosely fixed thereon between rigid collars or equivalent means, so that they will revolve thereon independently

of said shaft. f f' are other bevel-wheels, which respectively engage with the wheels F F' , and are secured to shafts f^2 f^3 , which have their bearings in the drum B and extend rearwardly therethrough and through stuffing-boxes b^6 b^6 , as shown, and are provided at their extremities with operating-handles f^4 f^5 . g g' are still other bevel-wheels, which also engage, respectively, with said wheels F and F' , and are secured to the ends of the shafts G and G' . The latter have their bearings in the brackets or boxes e^3 e^4 , formed on the inner surfaces of the side bars, e e , of the frame E . g^2 g^3 are worms formed on the shafts G G' , as shown.

H is a cylinder, from which proceeds rearwardly a shaft, h , having its bearings in the journal box or bracket h' . To the latter is secured a worm-wheel, I , which is loosely placed upon the shaft K , the ends k k of said shaft being rigidly secured in the forward ends of the side bars, e e , of the frame E . Said wheel I meshes with the worm g^3 on the shaft G' . Upon the shaft h is firmly fixed, so as to revolve therewith, a bevel-wheel, h^2 , which meshes with a bevel-wheel, l , upon the shaft K . Said wheel l is secured to or formed integrally with the worm-wheel L , both of which are loosely placed upon the shaft K in any suitable manner so as to revolve thereon. Said worm-wheel L meshes with the worm g^2 upon the shaft G .

H' is a piston-head sliding in the cylinder H , and M M' are the air or water supply tubes, having connection with said cylinder at m m' , as shown, and pass into the interior of the bell through the stuffing-boxes a^2 a^2 , and are therein each provided with a two-way cock, m'' , designed to be opened and closed by the foot of the operator by means of treadles or levers m^2 m^2 , or in any other suitable manner.

The piston H' is provided with a rod, h^3 , at the forward extremity of which, on either side, are formed the racks h^4 h^5 , which respectively mesh with the teeth of the segment-gears n n' , formed on the jaws N N' . The latter are pivoted at n^2 n^2 between the sides of a slotted bracket, H^2 , which projects from and is secured to or forms an integral part of the cylinder H . Said jaws N N' are provided with suitable gripping-faces n^3 n^3 .

O is a shaft passing through stuffing-boxes in the side of the bell in a line parallel to the longitudinal axis of the shaft B , and is provided at its outer extremity with a gear-pinion, o' , which meshes with the spur-wheel C , loosely secured to the shaft or drum B , and at its inner end with an operating-handle, o^2 .

P is another cylinder, secured to the side of the bell in such a manner that a rack, p , formed on the piston-rod p' will mesh, as shown in Fig. 4, with the spur-wheel b , rigidly secured to the drum B . The lower extremity of said piston-rod p' passes through and reciprocates in the bracket or bearing a^1 , affixed to the side of the bell.

p^3 p^3 are water or air supply pipes, connected to the cylinder P , as shown, and are operated with valves (not shown in drawings) to admit and exhaust the air or water to and from the said cylinder, to reciprocate its contained piston to operate the rod p' and rack p .

Operation: The diver or operator takes his position in the bell or car, and everything being in readiness, the bell, with its attachment, is lowered into the water to within a short distance of and near to the sunken object to be raised or otherwise operated upon, and the operator, according to the circumstances governing each case, manipulates the arm to make one or all, either successively or otherwise, of the following movements, of which said arm and its parts are capable:

First. If the valves controlling the admission of air or water pressure to the cylinder P be opened, so that the pressure of the air or water admitted therein will cause its piston and rod p' to descend, the rack p will then engage with the spur-wheel b , fixed to or forming a part of the shaft or drum B , thereby rotating the latter in the direction indicated by the arrow in Fig. 4, said drum B carrying with it the frame E , cylinder H , and jaws N N' . If the action on said valves be reversed, the piston ascends, and the said parts are then rotated in a direction the reverse of that indicated by said arrow; or, in other words, the reciprocation of the rack p rotates the entire prosthetic arm.

Second. If the handle o^2 be operated to revolve the shaft O , the revolution with said shaft of the pinion o' will rotate the loose spur-wheel C and its affixed bevel-wheel C' on the drum B , thereby causing the bevel-wheel C' to engage with and revolve the bevel-wheel d' , to rotate the shaft D and worm d , causing the latter to act upon the worm-wheel D' , firmly secured to the shaft e' , to rotate the latter upon its pivotal points e^2 e^2 , thereby causing the frame E , cylinder H , and jaws N N' to simultaneously oscillate together on said pivotal points, as shown by dotted lines 1 1 in Fig. 3; or, in other words, the revolution of the shaft O will, through the medium of the gear-wheels o' and C , bevel-wheels C' and d' , shaft D , worm d , and worm-wheel D' and shaft e' , cause the frame E , cylinder H , and jaws N N' to oscillate on the pivotal bearings e^2 e^2 while the drum B remains stationary.

Third. If the handle f^5 be operated upon to turn the shaft f^3 and bevel-wheel f' , attached thereto, the latter then rotates the loose wheel F' on the shaft e' , and causes said wheel to revolve the miter-wheel g' and the shaft G' , to which it is secured, thereby operating the worm g^3 on said shaft G' , to rotate the worm-wheel I on the shaft K . As the worm-wheel I is secured to the bracket h' , in which the shaft h of the cylinder H has its bearing, the latter, and with it the jaws N N' , are thereby alone oscillated by the rotation of said wheel I , as shown by dotted lines 2 2 in Fig. 3; or, in other words, the rotation of the shaft f^3 ,

through the interposition of the bevel-wheels f' F' g' , shaft G' , worm g^3 , and worm-wheel I , rotating on the shaft K , oscillates the cylinder H and jaws $N' N'$ only, the remaining parts

of the arm retaining their adjusted positions.

Fourth. If the handle f^4 be operated to turn the shaft f^2 and miter-wheel f , secured thereto, the latter rotates the loose bevel-wheel F on the shaft e' , which, in turn, meshes with and revolves the bevel-wheel g and its shaft G , thereby causing the worm g^2 , formed thereon, to rotate the loose worm-wheel L , and its affixed bevel-wheel l on the shaft K , the said wheel l thereby turning the bevel-wheel h^2 , secured to the shaft h of the cylinder H , thereby rotating said shaft h , cylinder H , and jaws $N' N'$ independently of the main drum B , as indicated by the dotted lines $y y$ in Fig. 3; or, in other words, the revolution of the shaft f^2 , through the medium of the bevel-wheels f , F , and g , shaft G , worm g^2 , worm-wheel L , and bevel-wheels l h^2 , and shaft h , rotates only the cylinder H and jaws $N' N'$, the main drum B , with all other attached parts, remaining in their fixed positions. If the drum B has been revolved one-quarter of its revolution on its axis by the rack p , the different vertical positions shown by dotted lines in Fig. 3 will then become horizontal instead of vertical, and as the movement of the drum B is less or more than a quarter-revolution, these positions will then be made at an angle between the vertical and horizontal.

When one, any, or all of these described movements have been made to bring the jaws $N' N'$ in proper position near to the sunken object which they are to grasp, the operator then places his foot on the treadle m^2 and opens the two-way valve m'' , introducing the air or water pressure into the cylinder H through the pipe M , causing the piston H' , with its rod h^3 and racks h^4 h^5 , to advance, said racks engaging with the segment-gears $n n'$ on the jaws $N' N'$, thereby oscillating the same on the pivots n^2 n^2 to open said jaws, as shown by dotted lines, Figs. 2 and 3. They are then, by any suitable movement above described, adjusted to embrace the sought-for object, when the operator then moves the treadle m^2 to turn the valves m'' to exhaust the air or water in the cylinder H through the pipe M , and admit it thereto through the pipe M' , thereby causing the piston H' , racks h^4 and h^5 , to recede to close the jaws $N' N'$ upon and hold the said object therein. Then, by any of the said described movements, it can be raised to and deposited in a separate basket lowered from above, when it can then be raised to the surface of the water.

Where greater power is required than that that can be exerted by the operator in the car to oscillate and rotate the cylinder H and jaws N , the shafts G G' f^2 f^3 , wheels f f' F F' g g' , and worms g^2 g^3 are dispensed with, and in lieu thereof cylinders are secured to the side bars, e e , of the frame E , and direct connection

made with spur-wheels L and I , which are then operated by air or water pressure acting on the pistons within the cylinders in a manner similar to that described for cylinders H and P . So, too, where a less powerful and a quicker movement is desired by which to oscillate and rotate the cylinder H and jaws $N' N'$ than is obtained by the worm-wheels L and I , the latter and the worms g^2 g^3 are then not used, and bevel-wheels, like wheels g g' , are substituted therefor, one of which is secured to the bracket h' and the others to the forward ends of the shafts G G' , that on the shaft G meshing with the bevel-wheel l on the shaft K , and that on the shaft G' meshing with the bevel-wheel secured to the bracket h' . The result is less powerful and much quicker than that obtained when the worms g^2 g^3 and worm-wheels L and I are employed.

In Figs. 1, 2, and 3 I have shown the jaws $N' N'$ as being pivoted to the bracket H^2 and operated by the piston-rod and interposed racks and segment-gear; but it is obvious that other constructions may be used with equal advantage—as, for instance, the racks and segment-gears may be dispensed with, and toggle-links substituted therefor, in which case one end of the links will be pivoted to the piston and the other end to the jaws.

Again, instead of the pivoted jaws $N' N'$, the construction shown in Fig. 5 may be employed, wherein N^2 N^2 are the jaws, one of which is rigidly secured to the cylinder H and the other to the piston-rod h^3 . The latter jaw is the movable one, and is reciprocated to and from the fixed jaw on the cylinder H by the direct action of the piston H' .

Where it is desirable to obtain a greater part of a revolution of the main drum B than can be secured by the rack p , or an entire one, a worm-gear and worm is substituted for the gear-pinion b and rack p , whereby an entire or any desired part of a revolution of the drum B is then obtainable.

The advantage of the foregoing is obvious. The diver is enabled to take his position in an inclosed diving-bell having a supply-tube communicating with the surface, and to perform, under the ordinary atmospheric pressure therein, with the aid of said described arm, all the various operations required for submarine work, without being subjected to the pressure of the superimposed water.

What I claim as my invention is—

1. A diving bell or car provided with a prosthetic arm or device and gripping-jaws, the latter being opened and closed by atmospheric or hydraulic pressure, substantially as shown and described.

2. A diving bell or car provided with a prosthetic arm or device and the several mechanisms, substantially as set forth, by means of which said arm is rotated on its main axis, its affixed parts are vibrated independently of the main shaft, and its cylinder and gripping-jaws are vibrated on their pivotal points, and are

also rotated on their axis independently of the remaining parts of the arm, substantially as shown and described.

3. In combination with a diving-bell, a prosthetic arm or device provided with a cylinder and attached gripping-jaws, the latter being opened and closed by atmospheric or hydraulic pressure, substantially as shown and described.

4. A diving-bell provided with a prosthetic arm having a cylinder and a pair of gripping-jaws, which are opened and closed independently of the pivotal connections of said cylinder, substantially as shown and described.

5. A diving-bell provided with a prosthetic arm having a cylinder and a pair of gripping-jaws, which are together independently rotated on their axis, substantially as shown and described.

6. The combination, with a diving-bell, of a prosthetic arm provided with a cylinder, gripping-jaws, and a supporting-frame, and interposed mechanism for simultaneously vibrating said cylinder, jaws, and frame, substantially as shown and described.

7. The combination, with a diving-bell, of a prosthetic arm and interposed mechanism for rotating said arm on its axis, substantially as shown and described.

8. A diving-bell provided with a prosthetic arm which is rotated by hydraulic pressure and provided with a pair of gripping-jaws which are opened and closed by atmospheric pressure, substantially as shown and described.

9. The combination, with a diving-bell, of a prosthetic arm, the main shaft or drum of which is rotated on its axis, the sections jointed thereto being independently vibrated on their pivotal connections, and the gripping-jaws and their operating mechanism swiveling on their axis independently of the rotation of the main shaft, substantially as shown and described.

10. In combination with a diving-bell, A, a prosthetic arm provided with the cylinder H and jaws N N', and the air or water conducting tubes M M', substantially as shown and described.

11. The combination, with the diving-bell A, the cylinder H, provided with the piston H' and piston-rod h^3 , the jaws N' N, and interposed mechanism for opening and closing said jaws, and the motor-supply tubes M M', all arranged substantially as shown and described.

12. In combination with the bell A, the shaft or drum B, spur-wheel b , cylinder P, and interposed mechanism for rotating said drum, substantially as shown and described.

13. In combination with the diving-bell A, the jaws N N', cylinder H, shaft h and bevel-wheel h^2 , and mechanism between the latter and the shaft G, the bevel-wheels g , F, and f , and shaft f^2 , substantially as shown and described, and for the purpose set forth.

14. In combination with the diving-bell A, the cylinder H, jaws N N', bracket h' , worm-wheel I, or its equivalent, and mechanism placed between the latter and the shaft G', the bevel-wheels g' F' f' , and shaft f^3 , substantially as shown, and for the purpose set forth.

15. The combination of the diving-bell A, shaft B, gear-wheels C C', shaft O and pinion o' , the shaft D, worm d , bevel-wheel d' , worm-wheel D', frame E, shaft e' , cylinder H, and jaws N N', substantially as shown and described, and for the purpose set forth.

16. The prosthetic arm, constructed substantially as shown and described, whereby it may be rotated on its axis, its jointed sections being free to oscillate on their pivotal bearings, and the gripping-jaws and their operating mechanism rotating on their axis independently of the main shaft or drum, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 19th day of May, 1879.

CHAS. F. PIKE.

Witnesses:

W. W. DOUGHERTY,
JAMES J. KEATING.