(No Model.) 3 Sheets—Sheet 1.

ADOLF GRAF VON BUONACCORSI DI PISTOJA.

AUTO-MOBILE TORPEDO.

No. 413,585. Patented Oct. 22, 1889.

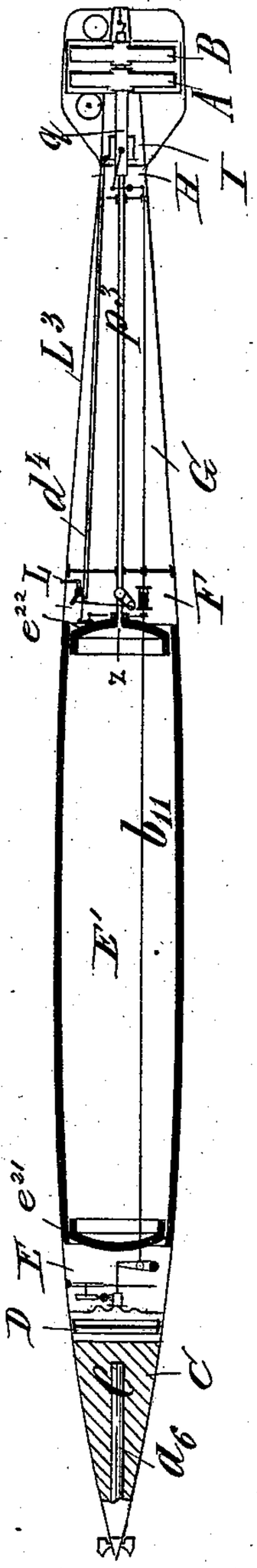

Fig. 1

Witnesses:
J. Thomson Cross
Will. E. Rouzee.

Inventor.
Adolf Graf von Buonaccorsi di Pistoja
per Henry Orth
Atty.

(No Model.) 3 Sheets—Sheet 2.

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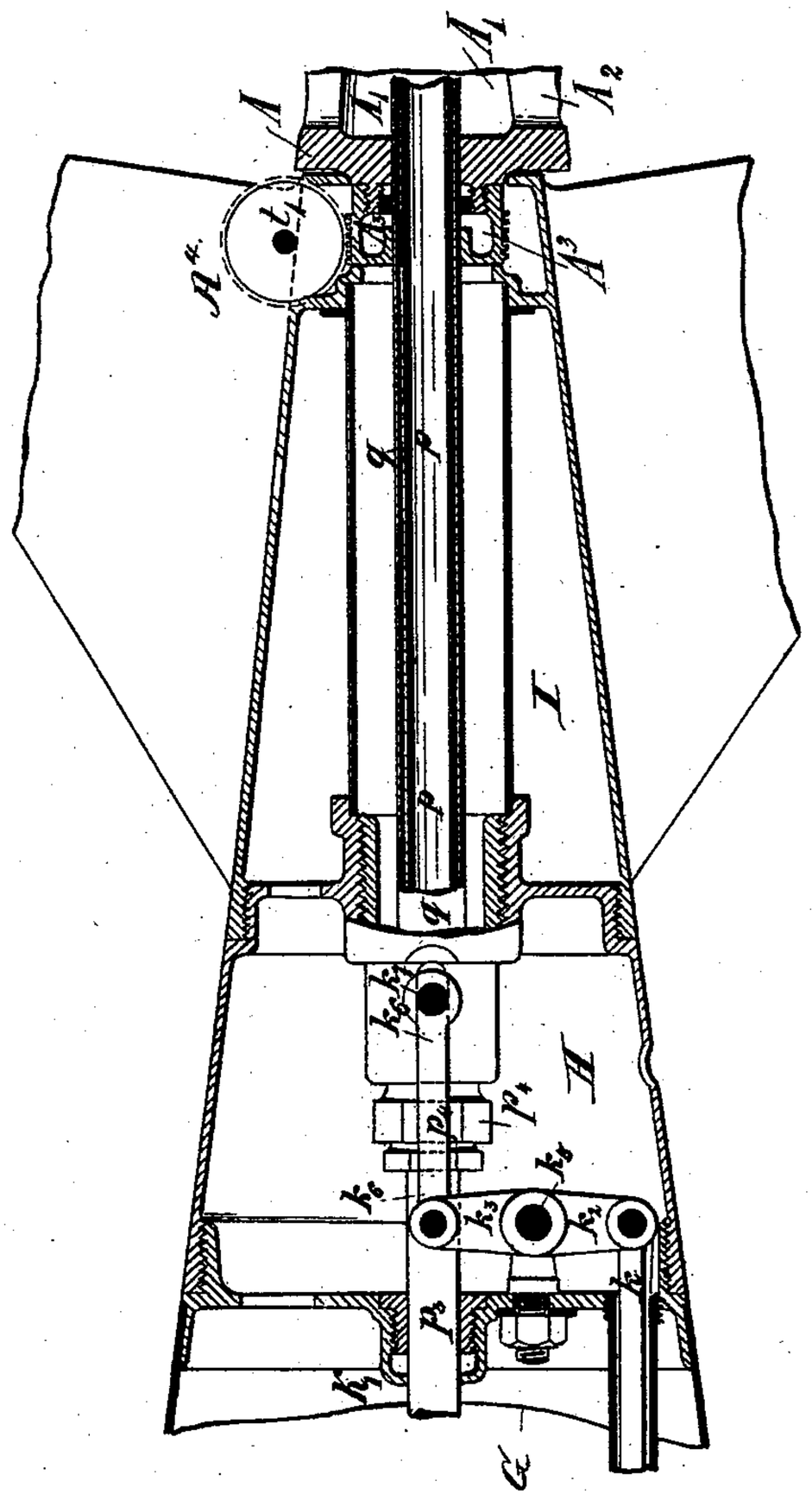

Fig. 2

Witnesses:
J. Thomson Cross
Mill. E. Rouzee.

Inventor
Adolf Graf von Buonaccorsi di Pistoja
per Henry Orth
Atty.

(No Model.) 3 Sheets—Sheet 3.

ADOLF GRAF VON BUONACCORSI DI PISTOJA.

AUTO-MOBILE TORPEDO.

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Fig. 4

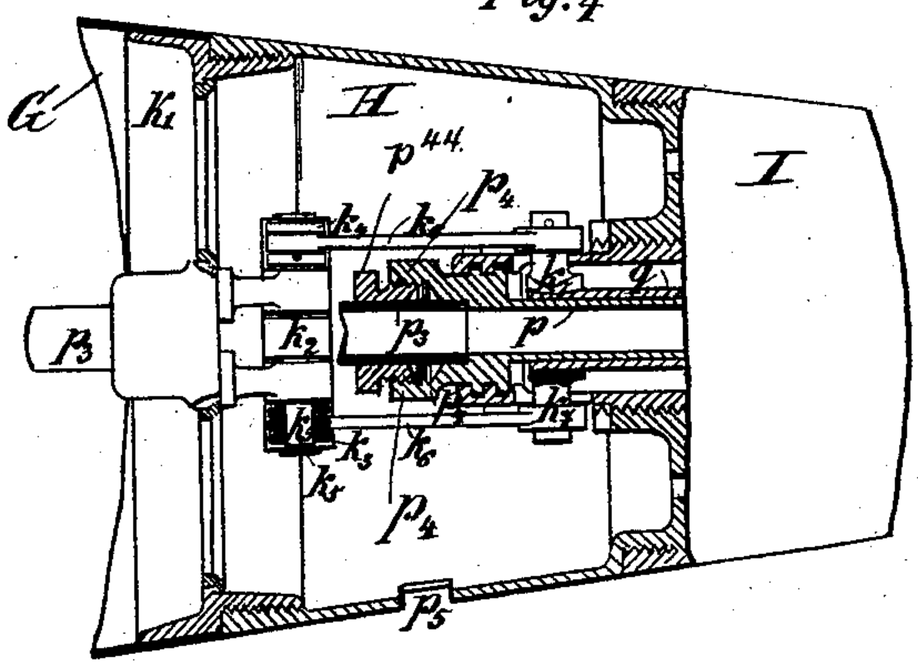


Fig. 3

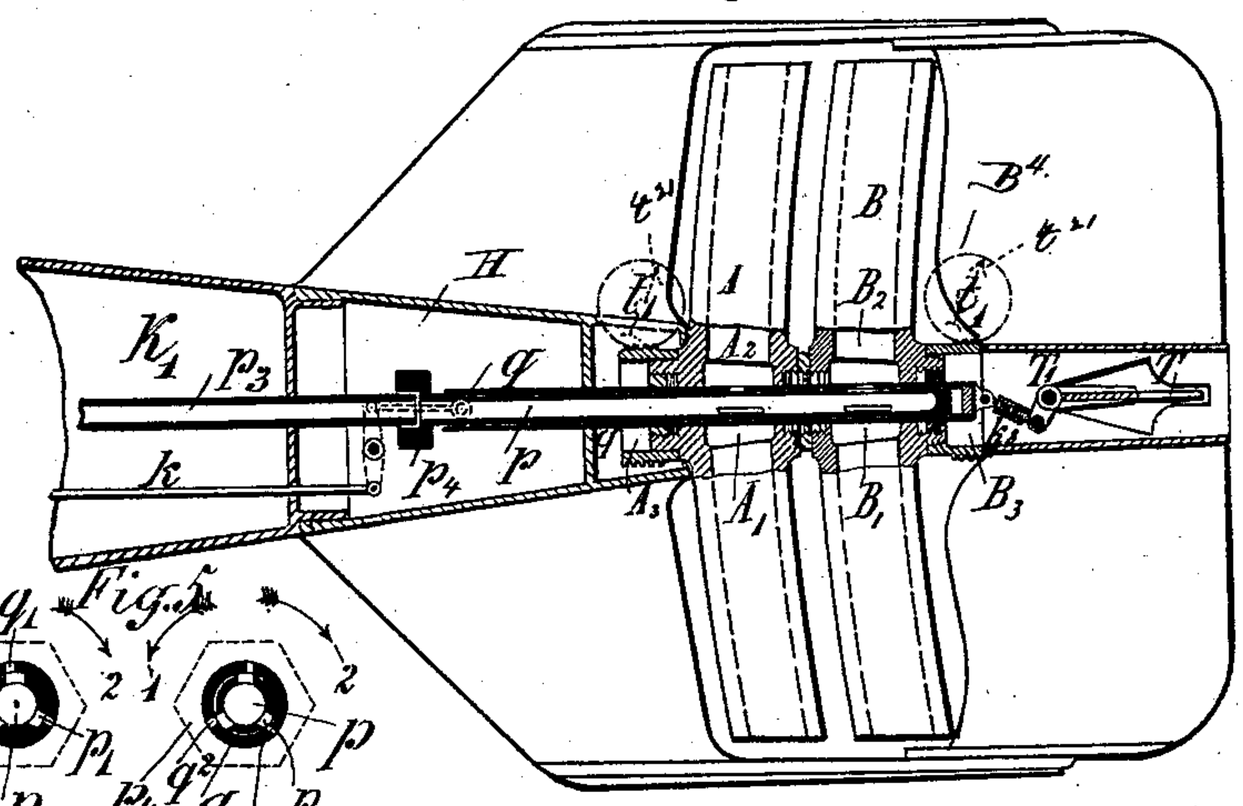
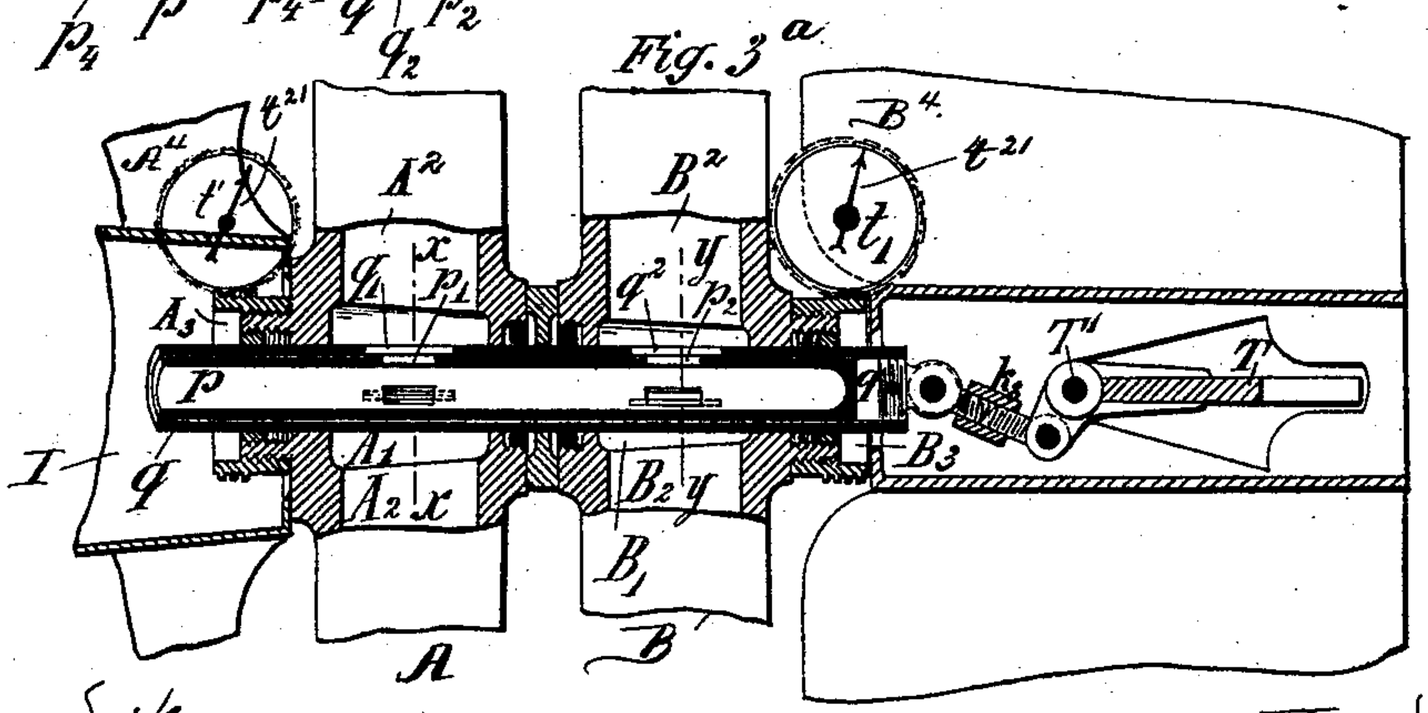


Fig. 5

Fig. 3a



Witnesses:
J. Thomson Crosse
Will. E. Bowen.

Inventor.
Adolf Graf von Buonaccorsi di Pistoja
per Henry Orth
Atty.

UNITED STATES PATENT OFFICE.

ADOLF GRAF VON BUONACCORSI DI PISTOJA, OF VIENNA, AUSTRIA-HUNGARY.

AUTO-MOBILE TORPEDO.

SPECIFICATION forming part of Letters Patent No. 413,585, dated October 22, 1889.

Application filed November 15, 1888. Serial No. 290,966. (No model.) Patented in Germany February 24, 1888, No. 49,125; in France February 24, 1888, No. 188,945; in Belgium March 12, 1888, No. 81,003; in England March 20, 1888, No. 4,297; in Italy March 31, 1888, XXII, 23,135, XLV, 431; in Portugal May 17, 1888, No. 1,244; in Norway May 28, 1888, No. 934; in Austria-Hungary June 26, 1888, No. 8,093 and No. 21,102, and in Spain June 30, 1888, No. 8,035.

To all whom it may concern:

Be it known that I, ADOLF GRAF VON BUONACCORSI DI PISTOJA, a subject of the Emperor of Austria-Hungary, residing at Vienna, in the Province of Lower Austria, in the Empire of Austria-Hungary, have invented certain new and useful Improvements in Self-Propelling Torpedoes, (for which I have obtained Letters Patent in Austria-Hungary, No. 8,093 and No. 21,102, dated June 26, 1888; in Germany, No. 49,125, dated February 24, 1888; in France, No. 188,945, dated February 24, 1888; in Belgium, No. 81,003, dated March 12, 1888; in Italy, Vol. XXII, No. 23,135, and Vol. XLV, No. 431, dated March 31, 1888; in Spain, No. 8,035, dated June 30, 1888; in Portugal, No. 1,244, dated May 17, 1888; in England, No. 4,297, dated March 20, 1888; in Norway, No. 934, dated May 28, 1888;) 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 appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

Referring to the drawings, Figure 1 is a longitudinal vertical sectional and more or less schematic view of a torpedo, showing its general construction and arrangement. Fig. 2 is a longitudinal axial section of the chambers in rear of the ballast or sinking chamber, illustrating the connection between the tubular bearing for the propeller-shaft and the distributing-pipe, as well as some of the mechanism for imparting a longitudinal motion to said propeller-shaft on its tubular bearing. Figs. 3 and 3ª are longitudinal axial sections of the rear end of the torpedo, illustrating the propellers and the arrangement of air-delivery ports, also showing the connection between the propeller-shaft and the horizontal or immersing rudder or fin, a portion of the vertical rudder and propellers being broken away in Fig. 3ª. Fig. 4 is a horizontal axial section of the chamber immediately in rear of the ballast or sinking chamber, illustrating the connections between the tubular bearing for the propeller-shaft and the air-main, and showing, also, a portion of the mechanism for imparting longitudinal motion to the propeller-shaft; and Fig. 5 shows sections on lines *x x* and *y y*, Fig. 3ª, the hexagonal head of the tubular bearing for the propeller-shaft being shown in dotted lines.

The invention relates to self-propelling offensive torpedoes of that class known as "fish torpedoes," and has for its primary object the application, as a propelling medium, of the principles involved in the Barker reaction-wheel.

To these ends the invention consists in the means for propelling the torpedo and in certain details of construction and combinations of parts, substantially as hereinafter fully described, and set forth in the claims.

The torpedoes to which the invention relates have heretofore been driven almost exclusively by means of compressed air utilized in the same manner as steam is—that is to say, by admitting the air to a piston cylinder or cylinders to drive a piston or pistons by the expansive power of the air, the reciprocating motion of the piston or pistons being converted into a rotary motion by connection of the piston-rod to a crank-shaft, the motion of the latter being transmitted by suitable gearing to the propeller-shafts in such manner as to cause the propellers to revolve in reverse directions. This mode of propulsion presents great disadvantages, in that considerable space is required for the accommodation of the piston-cylinders, the connections between their pistons and the driving-shafts, the governors, the slide-valves that control the operations of the pistons, and for the gearing between the driving and propeller shafts, a comparatively great amount of power being necessary to overcome the inertia of these mechanisms. There are, however, still further losses of power, due to various causes—as, for instance, to frictional resistance to the flow of the compressed air through the line-pipes,

both when admitting the air to or exhausting it from the piston-cylinders, thus limiting the speed of the torpedo accordingly.

By the application of the principles of the Barker reaction-wheel to the propulsion of the torpedo, the air-engines, their controlling valves and governors, the crank-shafts, the connections between said shafts and the power-pistons, and the gearing between the crank and propeller shafts are dispensed with, a single shaft carrying both propellers and serving at the same time as a conduit for the motive fluid being employed, and this shaft is connected directly with the compressed-air reservoir, which occupies nearly one-half the length of the shell of the torpedo.

The principle involved in the novel application of power, whereby the mechanism referred to can be dispensed with, consists in applying the power directly to the propellers, so that the live force, instead of the static pressure of the compressed air, is made available and utilized, and in admitting the compressed air in the form of jets of great velocity and density to the points where the power is to be applied, the air acting by aerodynamic impact upon the blades of the screw-propeller. It is evident that by such an application of the motive fluid the range of speed of the torpedo is very materially increased, while the inner space of the torpedo can be utilized to greater advantage, in that all the operating mechanisms may be arranged or contained within the torpedo-shell, instead of having to locate a great portion of such mechanism on the outside of such shell, as has been the case heretofore.

Inasmuch as the propeller-shaft is a non-rotating one, the said shaft may itself be used as a duct for the motive fluid, as above stated, both to the propellers as well as to other mechanisms—as, for example, the mechanism or intermediate mechanism that governs or controls the depth of immersion of the torpedo and automatic cut-off devices, there being sufficient space left for the use of a plurality of sinking or immersing valves instead of a single one, as has been the case heretofore, and such valves may be operated directly instead of indirectly, thereby increasing the efficiency of the mechanism employed for sinking the torpedo in case it should miss its aim, and such mechanism may be made to operate automatically and at the proper time, while the time required for filling the ballast or sinking chamber is materially shortened.

As a means for controlling the depth of immersion of the torpedo during its course through the water, I utilize the hydrostatic pressure of the ambient water, so that any variation in the depth of immersion will cause the correspondingly-varying hydrostatic pressure to operate the immersing-rudder to maintain the torpedo at a given depth during its course through the water. This mechanism I do not, however, claim herein; but it is shown, described, and claimed in my application for patent, Serial No. 271,047, filed April 18, 1888.

In the choice of the outlines of the torpedo it is the aim to preserve that form which presents the least resistance to motion through the water and has the least tendency to the formation of eddies, and at the same time to give to the compressed-air chamber a perfectly symmetrical form and to locate the same as near the bow or head of the torpedo as possible, thereby reducing the labor and cost of the construction of the air-chamber and facilitating the distribution of the weight of the entire structure and its contained mechanism, so that the persistence of the torpedo in its course through the water, which depends chiefly upon a perfect equalization or distribution of weight, is greatly increased.

In order that the invention may be better understood I will describe the same in detail, referring to the accompanying drawings.

In the construction of the torpedo I divide the hull or shell thereof as follows, referring to Fig. 1:

C is the chamber for the charge of explosive, located at the bow of the torpedo; D, a chamber open to the ambient water, to one of the walls of which is secured a diaphragm influenced by the hydrostatic pressure in said chamber.

E is a chamber containing the mechanism that is controlled by the diaphragm and the mechanism for returning the diaphragm into its normal position when moved out of it by the hydrostatic pressure in chamber D. The reservoir for the compressed air is indicated by E′, and F is the chamber that contains the devices for operating the admission-valve to admit the compressed air from the reservoir to the distributing-pipe, and also the intermediate mechanism that controls the immersing-rudder or horizontal fin.

G is the sinking or ballast chamber; H, the chamber that contains the mechanism for operating the sinking-valves and for imparting a longitudinal motion to the tiller or operating-rod of the immersing-rudder, and I is the chamber in which is contained the mechanism that controls the operating devices of the sinking-valves.

Although I prefer to employ all of the above-described mechanisms for more effectually controlling the movements and operations of the torpedo, yet some or all of them may be dispensed with and others employed; and as all of these mechanisms form subject-matter of separate applications for patents I have deemed it unnecessary to describe them in detail, except in so far as such description is necessary to the full comprehension of this invention. The motive fluid (air) is compressed to from seventy to ninety atmospheres within a cylindrical chamber or reservoir E′, Fig. 1, having dome-shaped heads or ends e^{21} e^{22}, respectively. To the head e^{22} is connected the distributing-pipe, which is preferably composed of three sections z, p^3, and

p. The section z is connected with the head e^{22}. The section p^3 is so connected with the section z as to adapt it to revolve for purposes presently explained, while the section p is rigidly connected with pipe-section p^3 by means of a coupling-head formed thereon or secured thereto, and a stuffing-box gland p^{44}, as shown in Fig. 4. The pipe p is closed at its outer end and serves as a bearing for the tubular propeller-shaft q. On the propeller-shaft q are mounted two screw-propellers A and B, so as to rotate freely on said shaft, said propellers having their blades curved in opposite directions, the blades of the propeller A being, for instance, portions of right-hand screw-threads, while those of B are portions of left-hand screw-threads. In the hub of each propeller is formed an axial chamber A′ and B′, respectively, that has the form of a truncated cone in longitudinal section, and through which the shaft q passes, and into which the compressed air is admitted through ports p' and p^2 and q' and q^2, formed in pipe p and shaft q, respectively, said ports p' p^2 registering with those q' q^2, respectively, and with the axial chambers A′ B′ in the propeller-hubs A B, which chambers here perform the function of auxiliary reservoirs, and which jointly with the moment of inertia of the revolving propellers regulate the speed of the torpedo, the air flowing out through passages A^2 A^2 B^2 B^2, Figs. 3 and 3^a, formed in the blades of the propellers. The aerodynamic impact of the rapidly-moving molecules upon the opposite elements of the sides of the passages, as well as the recoil exerted in a direction the reverse of that of the movement of the said molecules, causes the screw-propellers to revolve in the direction of the curvature of their helical blades. In this mode of rotating the propeller-blades, which is based upon the principles involved in the Barker reaction-wheel, the speed of one propeller is rendered quite independent of that of the other and depends entirely upon the area of the ports through which the air is admitted to the chambers A′ and B′—that is to say, to the volume of compressed air admitted to said chambers.

The diverting action of a single screw-propeller upon the course of a torpedo is well known, and to compensate this action in part a second propeller rotating in a reverse direction and at the same speed has been used, the direction of motion being maintained through the agency of vertical rudders. The unequal action of two propellers, which has heretofore been regarded as a disturbing factor in the direction of the torpedo, is by my invention made available as a factor for directing or maintaining the torpedo in its course. Since the deviating or diverting action or effect of the propellers increases or decreases in the same ratio as their speed of revolution, I found that by providing proper means this difference in the deviating action of the propellers may be made sufficiently great, so that the action of one will compensate the action of the other propeller, as well as other deviating influences exerted on the torpedo; and as the speed of rotation of propellers depends upon the volume of air acting directly upon them, or, in other words, upon the area of the ports that admit the air to the propellers, it is obvious that by a proper adjustment of these areas relatively to each other a corresponding steering action will be exerted upon the torpedo. The variation in or adjustment of the area of the admission-ports p' q' p^2 q^2 is accomplished by simply revolving the pipe p within the shaft q so as to more or less cover the ports q' q^2. These ports q' q^2 are only one-half the diameter of the ports p' p^2, and are formed by longitudinal slots that do not lie in the same longitudinal plane relatively to each other, so that by properly positioning the pipe p the area of the ports, and consequently the volume of air admitted to the propeller-chambers, may be regulated at will. As shown in Figs. 3 and 3^a, these ports communicate with the passages A^2 B^2 of the propeller-blades through the annular conical chamber A′-B′ in the hubs of the propellers A and B, so that the volume of compressed air admitted directly to the said chambers and passages. Consequently the speed at which the propellers rotate will depend upon the adjustment of the port-areas, and that the propeller A may be rotated at a greater speed than the propeller B, or vice versa. The adjustment of the tube p within the shaft q is effected by means of a key or wrench applied to the angular head p^4, Figs. 2 and 4, at the inner end of the pipe p, whose outer end is closed, as well as the outer end of the shaft q, as above stated, and, as shown, the outer end of shaft q is closed by a screw-plug to which the horizontal rudder is connected. It will be seen by an inspection of Figs. 3^a and 5 that by a partial rotation of the head p^4 of pipe p (shown in dotted lines in Fig. 5 and in full lines in Figs. 2 and 4) in the direction of arrow 1 the ports p' q' in pipe p and shaft q will cease to register, the air being cut off from the propeller-chamber A′, while the ports p^2 will still fully register with the ports q^2, thus applying the full motive power to the propeller B. A partial rotation of the pipe p in a reverse direction, or that of arrows 2, will produce a reverse result.

In order to permit of the adjustment of the ports referred to after the torpedo is completed, I provide a suitable slot p^5, formed in the torpedo-shell, Fig. 4, for the introduction of a key or wrench, as stated above.

In trial-launching to determine the speed of the torpedo and in order to regulate the relative speed of the two propellers, so that the deviating action thereof may be counteracted, it is necessary to ascertain the number of revolutions of the propellers under given pressures of air. To this end I provide a reg-

istering mechanism that comprises a graduated dial *t*, revoluble on a fixed arbor that carries an index t^{21}, as shown in Figs. 3 and 3ª.

I have stated hereinbefore that the propeller-shaft is connected to the immersing or steering rudder T, and consequently also performs the function of tiller.

As the means for imparting longitudinal motion to the propeller-shaft *q* for operating the rudder T have been fully described and claimed in an application for Letters Patent filed April 18, 1888, Serial No. 271,047, it will not be necessary to again describe them here. It will, however, be obvious that the said rudder may be operated by any other means and that the propeller-shaft *q* may be connected with or mounted on the pipe *p* as not to move longitudinally. In fact, the propeller-shaft may be connected directly to the compressed-air reservoir, and other means than those shown may be employed for adjusting the port-areas to impart to the propellers a uniform or a variable speed—as, for instance, a short cylinder adapted to be partly revolved in shaft *q* and provided with delivery-ports *p'* p^2 may be inserted in shaft *q* from the rear end and adjusted from that end.

Any suitable means may be employed to admit the compressed air to and cut it off from the distributing-main—as, for instance, a suitable valve or stop-cock may be interposed in the pipe *z*, or the propeller-shaft *q*, when said shaft is connected directly with the compressed-air reservoir. I prefer, however, to employ the valve mechanism fully shown and described in my application for patent filed November 15, 1888, Serial No. 290,968, whether such mechanism is applied as therein shown or whether it is applied to the propeller-shaft *q* where said shaft is connected directly with the compressed-air reservoir, such changes in the arrangement of the devices referred to being within the province of the skilled mechanic.

Having described my invention, what I claim is—

1. In a torpedo, the combination of a non-rotary supply-pipe for conveying the motive power under pressure, having outlet-ports, with a screw-propeller provided with outlet-ducts through its blades and formed with a hollow hub which is journaled upon said supply-pipe at said ports and communicates with said ducts, substantially as described.

2. In a torpedo, the combination, with the compressed-air reservoir, the supply-pipe *p*, having two separate rows of side discharge-ports and conveying the motive fluid under pressure, and the tubular propeller-shaft *q*, having two corresponding rows of side discharge-ports, of two independent screw-propellers having their blades curved in opposite directions, and curved channels terminating in openings in the line of said curves and communicating with the said side ports in both the said pipes, substantially as described, for the purpose specified.

3. In a torpedo, the combination, with the compressed-air reservoir, the supply-pipe *p*, having two separate rows of side discharge-ports and conveying the motive fluid under pressure, and the tubular propeller-shaft *q*, having two corresponding rows of side discharge-ports, of two independent screw-propellers having their blades curved in opposite directions, and curved channels terminating in openings in the lines of said curves and having chambered hubs, into the chambers whereof the ports of both pipes open, and into which chambers the said curved channels open, whereby the said propeller-chambers serve as auxiliary reservoirs for the motive fluid which operates the propellers.

4. In a torpedo, the combination of a supply-pipe for conveying the motive fluid under pressure and provided with delivery-ports, a tubular shaft upon said pipe, having means for being moved longitudinally upon the same and having ports of greater longitudinal area than those of the supply-pipe and registering therewith, a screw-propeller journaled upon said shaft and having hollow blades communicating with said ports, and an immersing-rudder controlled by the longitudinal motion of said shaft, substantially as described.

5. The combination, with the screw-propellers A and B, the blades whereof are curved in reverse directions, said propellers having chambered hubs and an open passage formed in the blades thereof, of a tubular shaft connected with a source of motive fluid under pressure, on which shaft said propellers are loosely mounted, provided with delivery-ports registering with the propeller-hubs, and a tubular valve revoluble in the propeller-shaft and provided with ports adapted to register with the shaft-ports, whereby the area of the shaft-ports may be adjusted, substantially as and for the purposes specified.

6. The combination, with the screw-propellers A and B, the blades whereof are curved in reverse directions, said propellers having chambered hubs and an open passage formed in said blades, of a tubular shaft connected with a source of motive fluid under pressure, on which shaft said propellers are loosely mounted, provided with ports arranged in different longitudinal planes and registering with the propeller-hubs, and a tubular valve arranged within the propeller-shaft and having ports of greater area than the shaft-ports, arranged in the same longitudinal plane and adapted to register with the shaft-ports, whereby the relative area of the shaft-ports may be varied to vary the relative speed of the propellers, substantially as and for the purposes specified.

7. In a torpedo, the combination, with the propeller or propellers and the horizontal or

immersing rudder, of a tubular propeller-shaft having an endwise motion in its bearings, said shaft being connected with and controlling the immersing-rudder, substantially as and for the purposes specified.

8. The combination, with the pipe p, closed at one end and connected at the other with a source of motive fluid under pressure, said pipe being revoluble and provided with ports p' p^2, arranged in the same longitudinal plane, of the tubular shaft q, mounted on pipe p and provided with ports q' q^2, arranged in different longitudinal planes, said ports being of less area than and adapted to register with the ports p' p^2, and reaction-propellers A B, loosely mounted on shaft q, substantially as and for the purposes specified.

9. The combination, with the pipe p, closed at one end and connected at the other with a source of motive fluid under pressure, said pipe being revoluble and provided with ports p' p^2, arranged in the same longitudinal plane, of the tubular shaft q, mounted and movable longitudinally on pipe p, said shaft being provided with ports q' q^2, arranged in different longitudinal planes and of less transverse area and of greater longitudinal area than the ports p' p^2 of pipe p, reaction-propellers A B, loosely mounted on shaft q, and a horizontal or immersion rudder controlled by said shaft, substantially as and for the purposes specified.

10. In a torpedo, the combination, with the compressed-air reservoir and the supply-pipe conveying the motive fluid under pressure, of two independent screw-propellers mounted loosely upon the same shaft, revolving in opposite directions and provided with worms upon their hubs, a registering device for each propeller having gearing engaged by said worms, and means, substantially such as described, for regulating the volume of air admitted to the propellers and the relative speed thereof, whereby the deviating or diverting action or effect of one propeller in relation to the other is ascertained and counteracted or compensated.

In testimony whereof I affix my signature in presence of two witnesses.

ADOLF GRAF VON BUONACCORSI DI PISTOJA.

Witnesses:

OTTO SCHIFFER,

OTTO MAAS.