

(No Model.)

2 Sheets—Sheet 1.

H. V. HAYES.

TELEPHONE APPARATUS FOR DIVERS.

No. 353,940.

Patented Dec. 7, 1886.

Fig. 1.

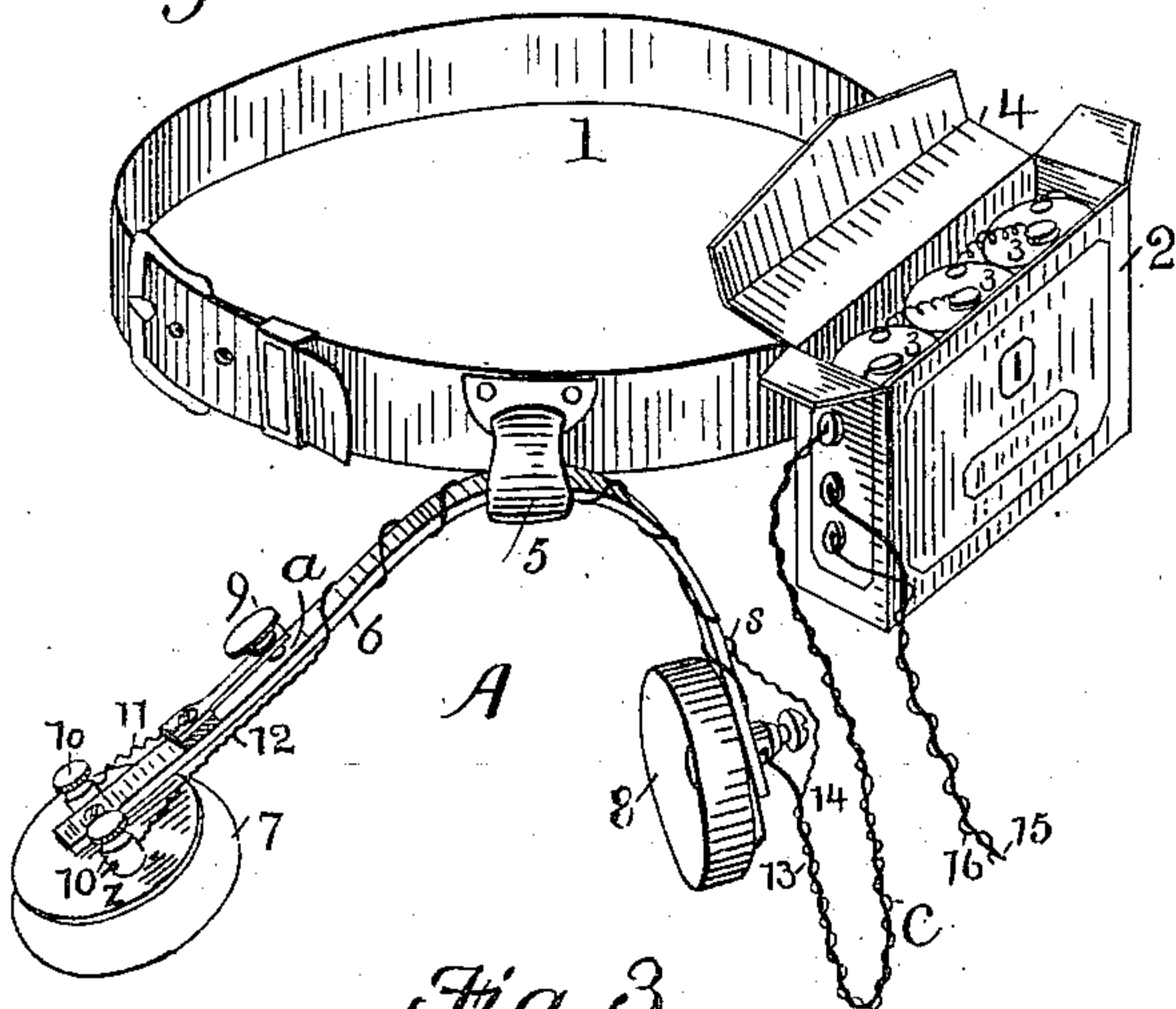


Fig. 3.

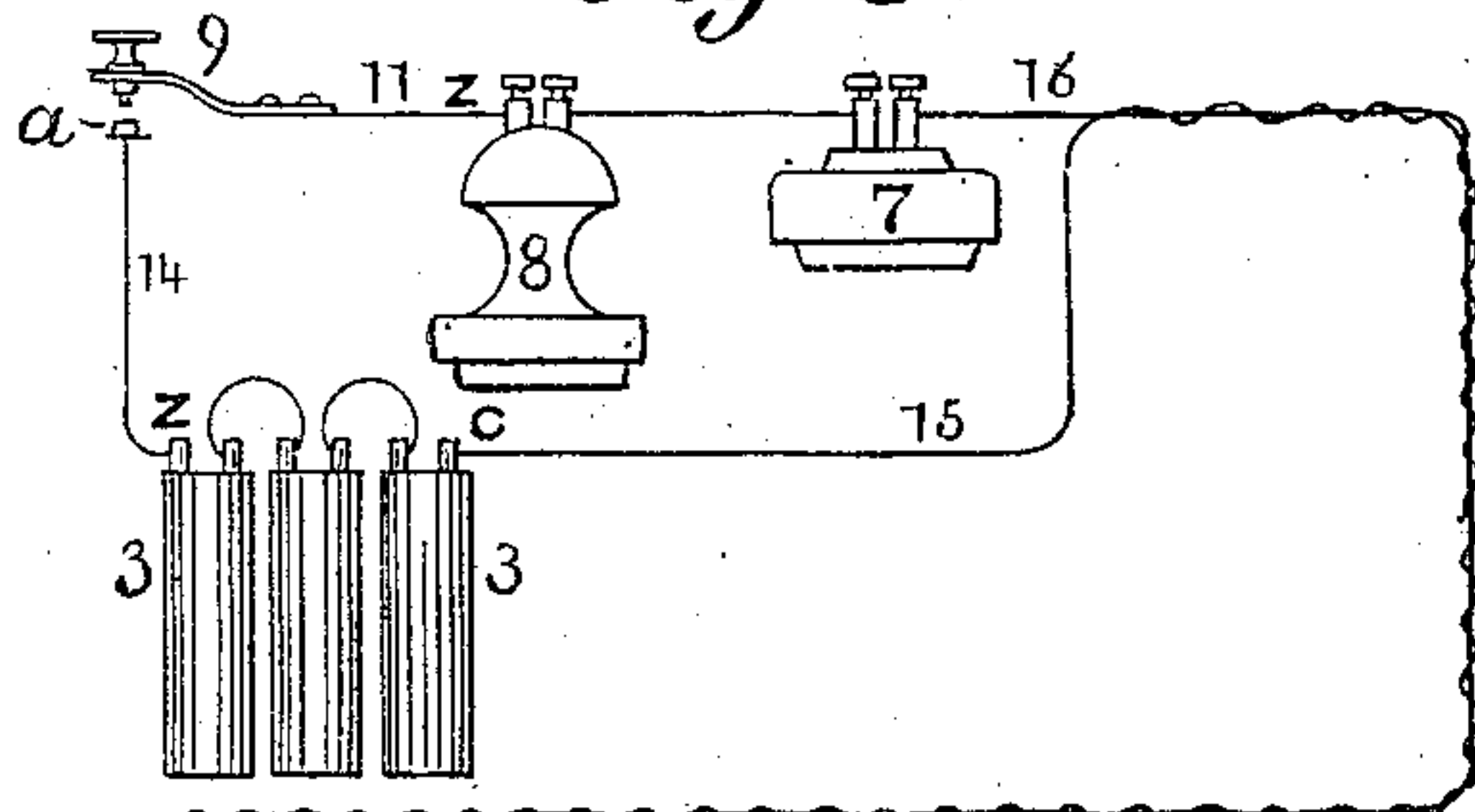


Fig. 4.

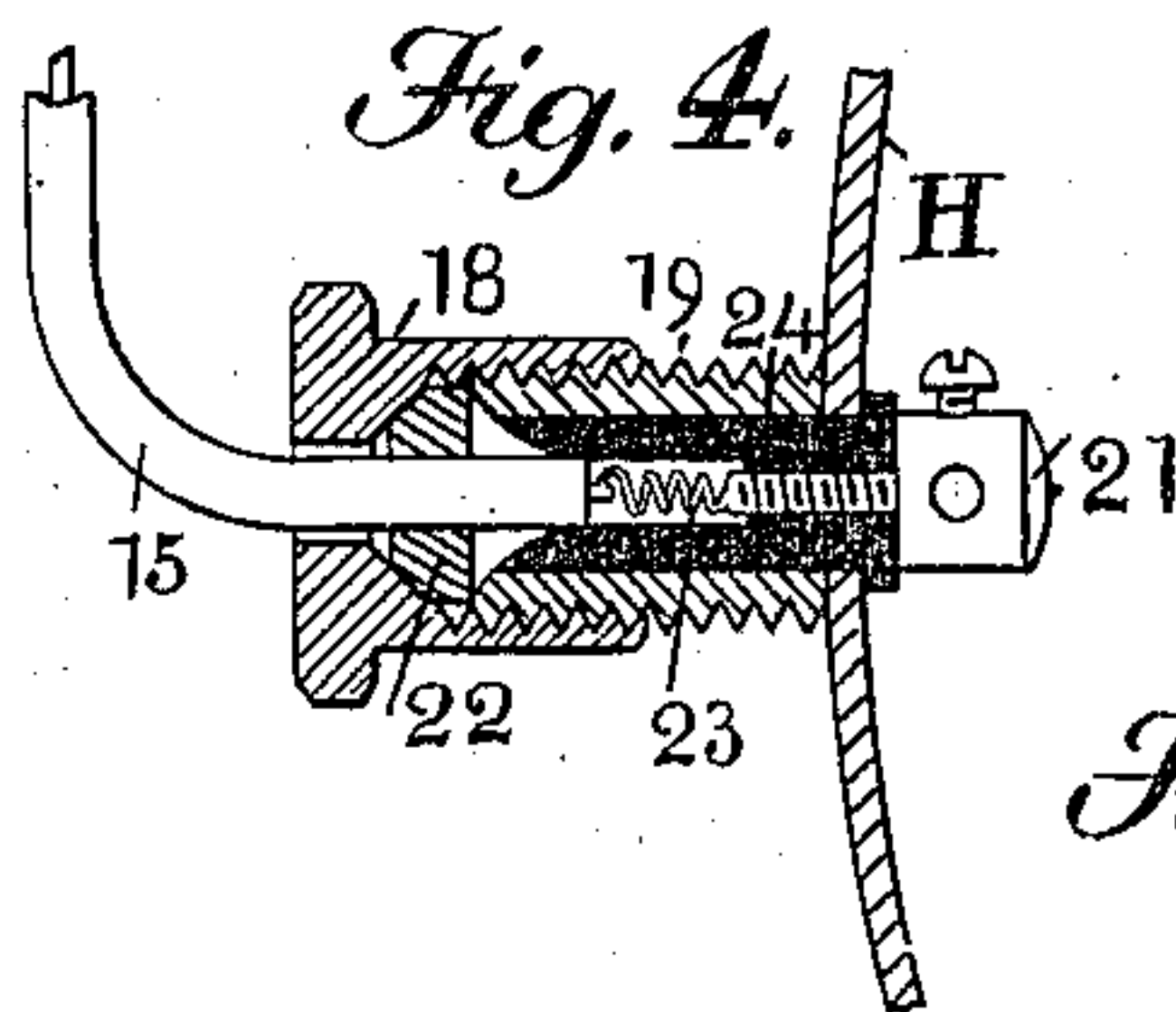
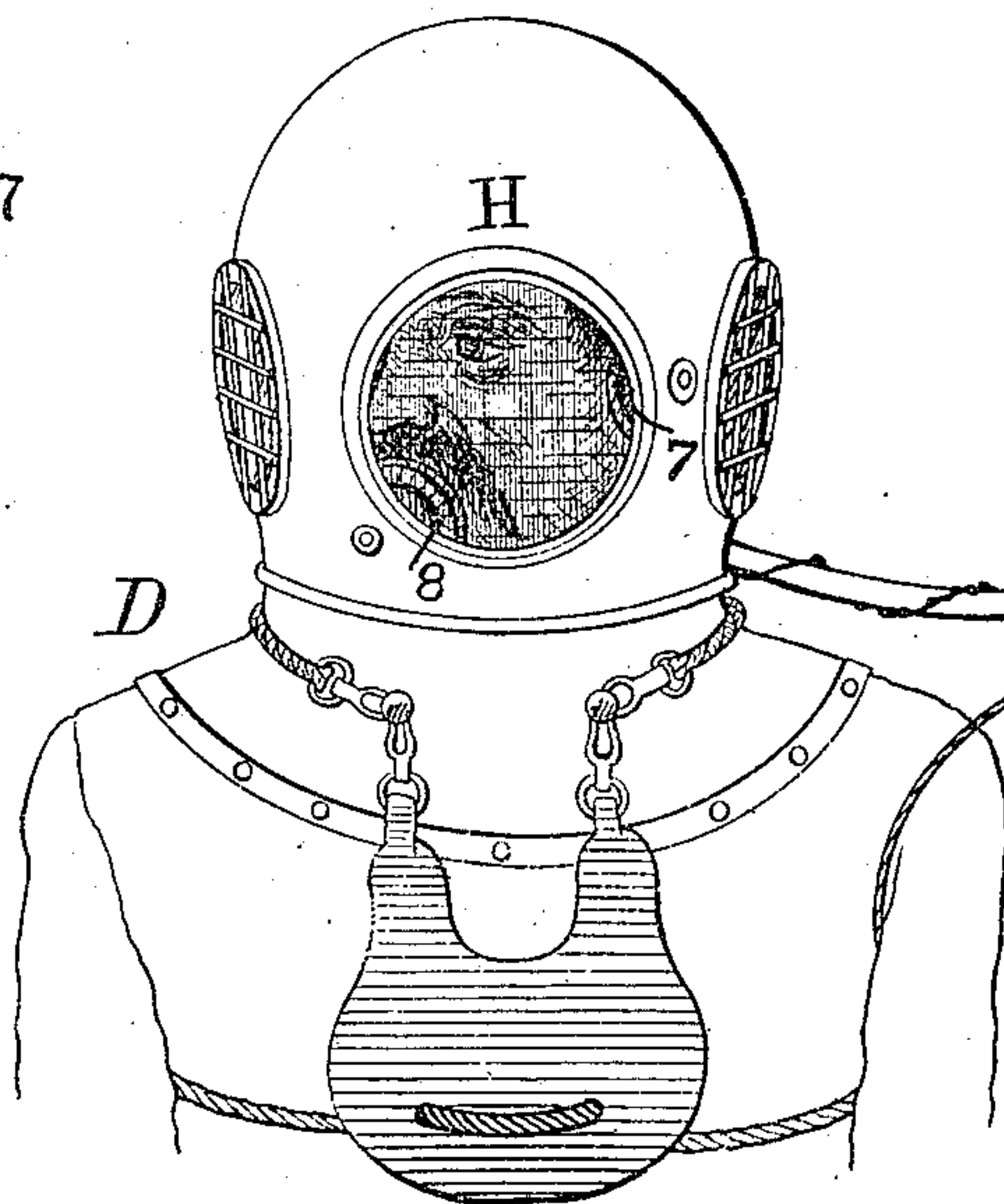
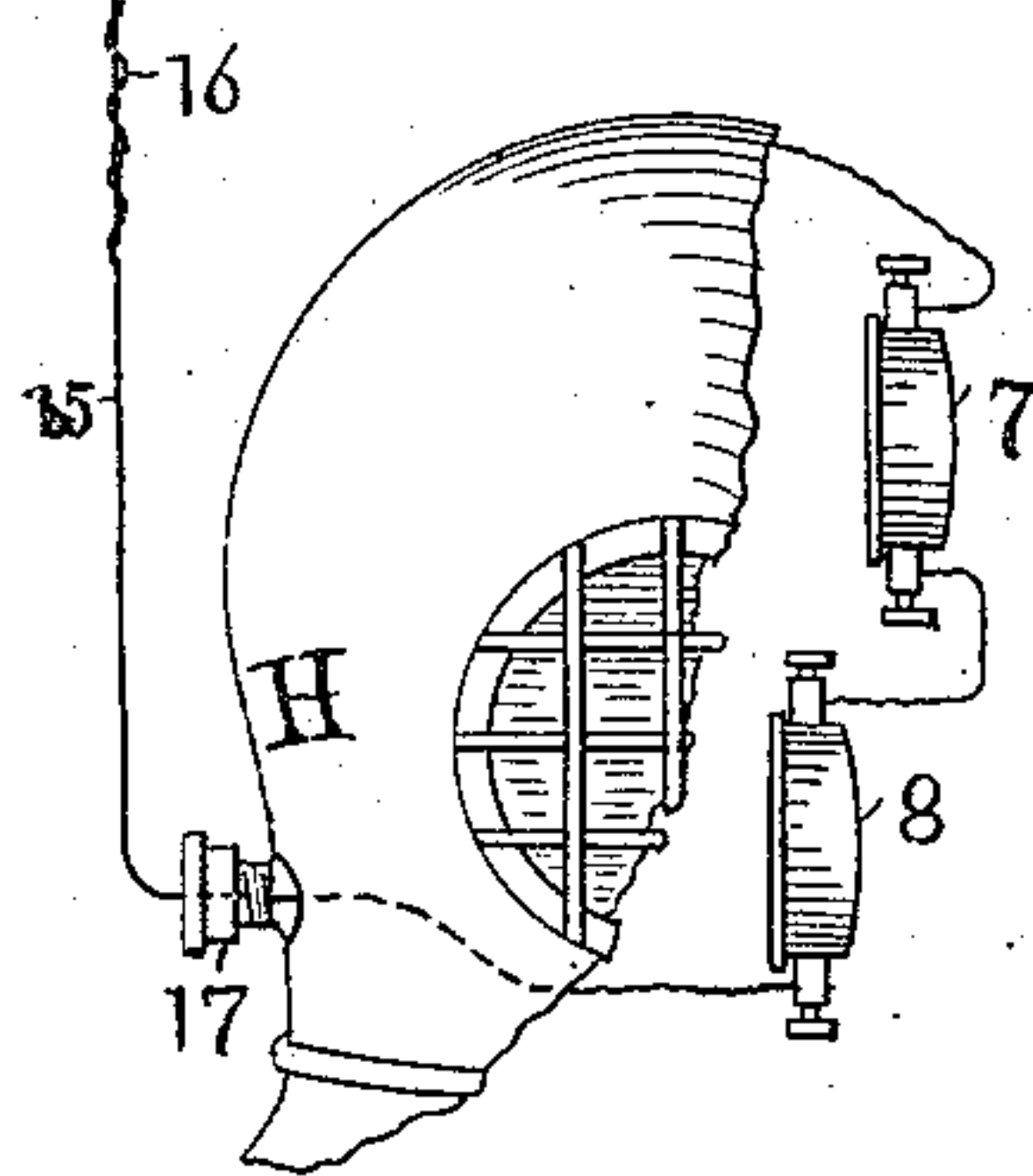


Fig. 2.



Witnesses.
Geo. Willis Pierce,
Thos D Lockwood

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H. V. Hayes.

(No Model.)

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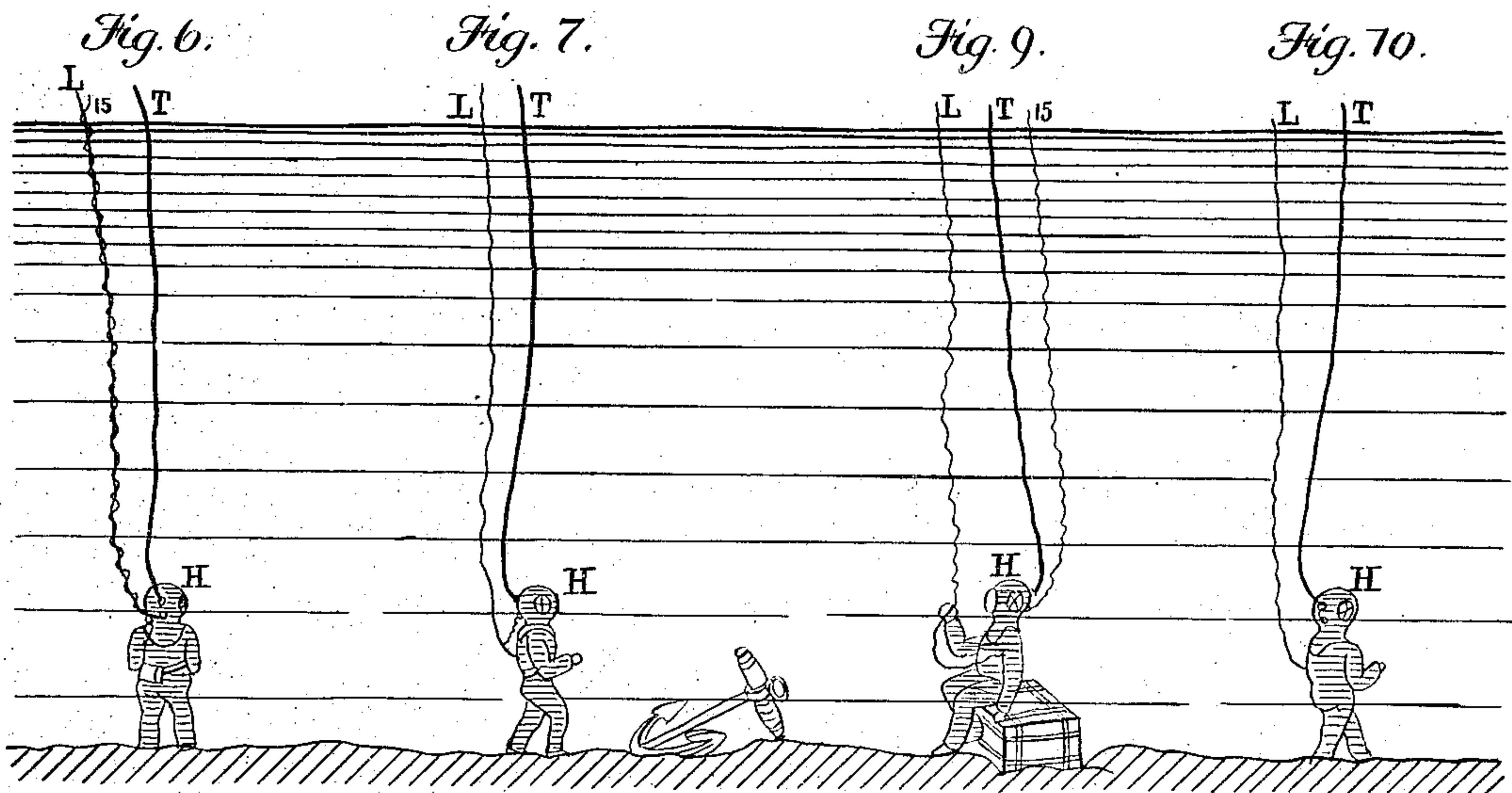
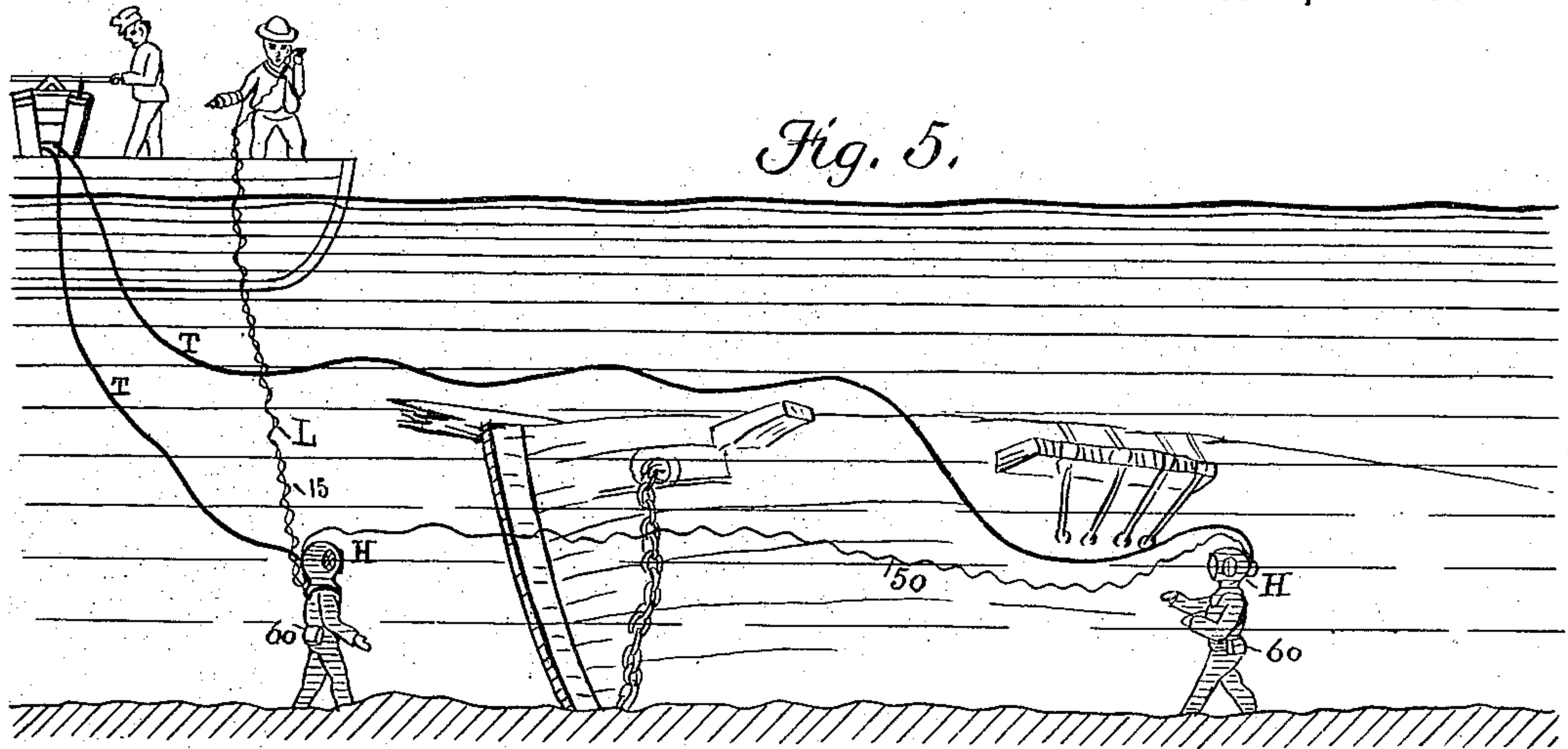


Fig. 8.



Fig. 13.



Fig. 12.

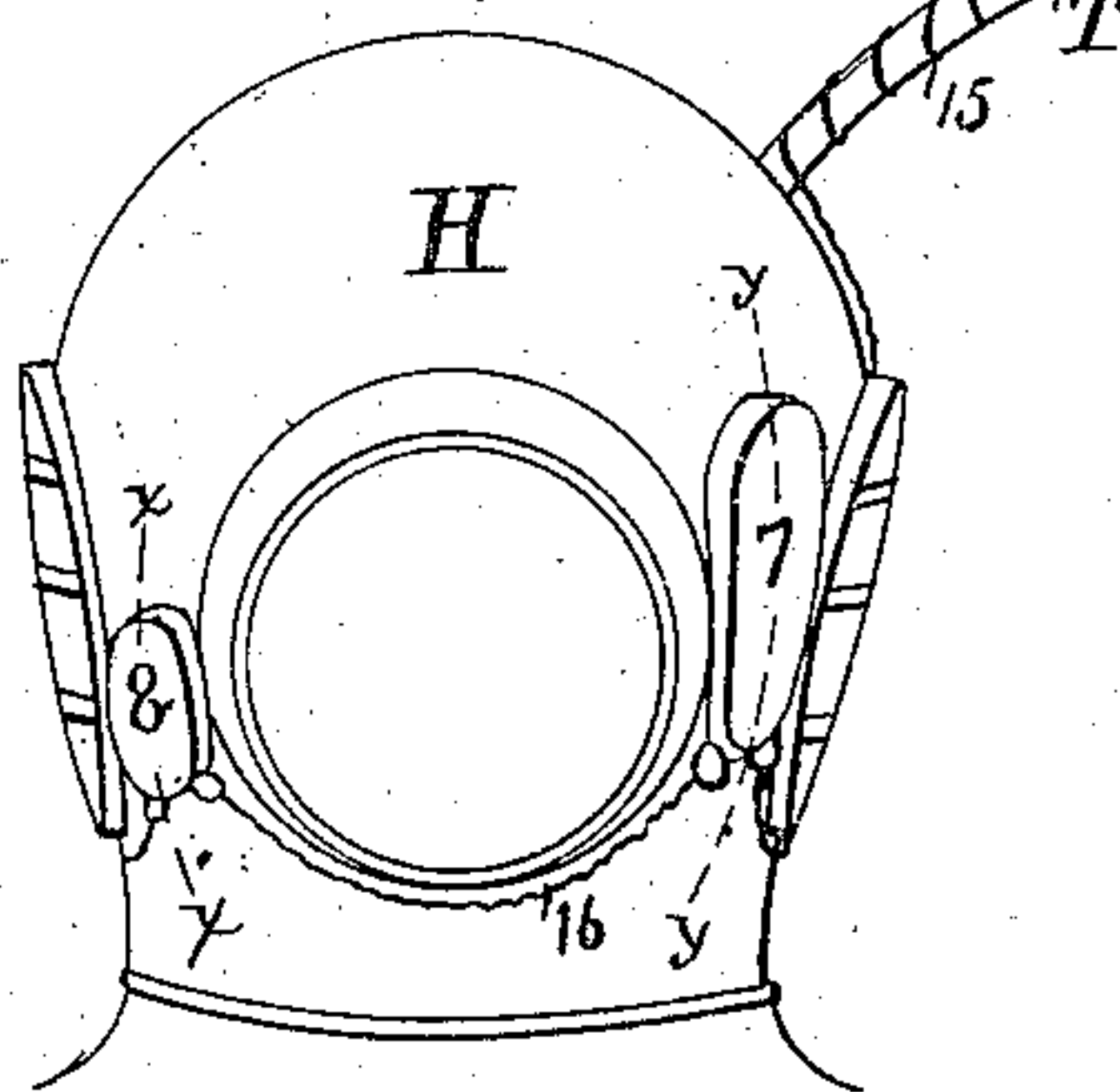


Fig. 11.

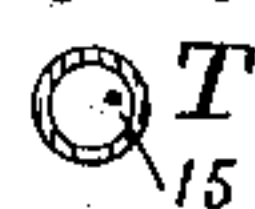


Fig. 14.



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Geo. H. C. Trouvelot.

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UNITED STATES PATENT OFFICE.

HAMMOND VINTON HAYES, OF CAMBRIDGE, MASSACHUSETTS.

TELEPHONE APPARATUS FOR DIVERS.

SPECIFICATION forming part of Letters Patent No. 353,940, dated December 7, 1896.

Application filed July 2, 1886. Serial No. 206,924. (No model.)

To all whom it may concern:

Be it known that I, HAMMOND VINTON HAYES, residing at Cambridge, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Telephone Apparatus for Divers, of which the following is a specification.

My invention relates to the application of electric telephones to the outfit of divers, so that oral communication can at all times be maintained between a diver when under water and his associate upon the land. Heretofore, and prior to my invention, so far as I am aware, all attempts to establish telephonic communication under such circumstances have been of tentative character, and have only attained a partial degree of success.

The object of this invention is to provide telephonic communication by the use of devices which shall combine a high standard of efficiency in operation with perfect reliability, considerable permanency, and extreme simplicity of construction. The characteristic which I have mentioned last is absolutely essential, since the apparatus is used by persons of no experience in electrical appliances. This object is attained by the apparatus constituting my invention, which consists in combining the diver's helmet with telephones connected by an electric circuit with a corresponding telephone outfit to be stationed upon the land.

It further consists in attaching to the inside of the helmet transmitting and receiving telephones the connecting-wire entering through a stuffing-box; in combining with the land-telephones a belt and portable battery-box, whereby the instruments and necessary appliances can be comfortably and conveniently worn by an attendant, and in including the telephone-instruments all in a battery-circuit, whereby a single battery located upon the shore is enabled to energize the complete circuit.

In the drawings by which the invention is illustrated, and which form a part of this specification, Figure 1 is a perspective view of the land outfit, consisting of the attendant's belt, the battery-box and battery supported thereby, and a combined transmitting and receiving telephone resting in a hook or clip thereon. Fig. 2 is a drawing representing the diver's telephones in circuit, and an attendant

upon the shore communicating with the diver. Fig. 3 is a diagram of the electrical connections and the arrangement in circuit of the several appliances, and Fig. 4 is a detail showing in section the coupling or stuffing-box by which the conducting-wire enters the diver's helmet. Fig. 5 illustrates means of communication between two or more divers under water. Figs. 6 to 14, inclusive, are views of certain details or modifications, as hereinafter more particularly set forth.

I have ascertained by actual experiment that it is quite possible to exchange messages between a diver and his attendant intelligibly by the use of magneto-telephones exclusively. It is, however, not convenient, by reason of the noise made by the escaping air and the consequent necessity of temporarily closing the air-valve, which engages the diver's attention, and compels him to hold the air-valve close with his hand or by lying on his back when communicating with the person on shore. I prefer, therefore, to provide both the diver and his attendant with a battery-transmitter, which enables the words to be reproduced loudly and distinctly. Moreover, since it is requisite that the diver should not have his freedom of movement hampered or restrained in the slightest degree, and since divers, as a class, strenuously object to anything which tends to such interference, it has not been found advisable to provide a battery and induction-coil for each transmitter in the usual manner, since such a provision would obviously necessitate one of two conditions, both objectionable—i. e., in the first case the diver would have to be encumbered with the addition of these appliances; or, on the other hand, additional wires would be required to connect his telephones with battery and induction-coil on the shore. I have therefore adopted the expedient of using a transmitter which is adapted for use in connection with a battery in the main circuit—such a one, for example, as the now well-known "Hunnings transmitter"—and I connect in practice the transmitters and receivers both over and under water in circuit with a voltaic battery carried, as hereinafter described, by the attendant upon the shore. It will be of course understood that to obtain the best results from this plan the receiving-telephones must be wound with

wire of low resistance, so that the current of the battery shall not be impaired in strength.

In Fig. 1 the shore appliances are represented comprising a belt, 1, to be worn by the attendant, to which is attached a box or case, 2, preferably of leather, inclosing the battery, the cover 4 of which can be secured by a lock, or in any desired way. Wires 15 and 16 are shown leading from this battery-box down to the diver's apparatus, and other wires, 13 and 14, lead from the battery-box to the transmitter 8 and receiver 7, through the circuit-closing key 9, supporting-bar 6, and wire 12. The key-anvil *a* is in electrical connection with the bar 6, although it would obviously be equivalent in effect if the said bar were not included in the circuit and if the wire 14 were, in lieu of said inclusion, connected directly with the anvil *a*, instead of being united to the stud *s*, which is in metallic union with said bar. The belt is further provided with a hook, 5, within which the telephone may rest when not actually in use.

The transmitter 8 is, as hereinbefore indicated, one of the Hunnings type, in which a mass of granulated carbon is inclosed between two conducting-plates included in the line-circuit, while the receiving-telephone 7 is preferably constructed substantially upon the plan elaborated and described in Letters Patent issued June 8, 1886, to E. T. Gilliland, No. 343,449, in which a cast-iron cup, forming the diaphragm-seat, incloses a soft-iron magnet-core surrounded by an electro-magnetic helix included, by means of screw-posts 10, in the line-circuit. I am not, however, restricted to the use of these special instruments, since, especially at the land-station, any suitable telephones may be employed without departing from the spirit of my invention.

Fig. 2 shows the method of using the diver's telephones. The attendant upon the shore is represented as being in the act of using the combination-instrument A, which, by means of the double conductor *c*, is united electrically to binding-screws fixed upon or within the battery-case 2, which the said attendant carries at his belt 1.

The main wires 15 and 16 are, for convenience, twisted round the air-tube T, which is led into the helmet H of the diver D, the main wire 15 (which is of course carefully insulated) being also conducted into the helmet through the coupling or appliance 17, (shown in Fig. 4,) in which H represents the side of the helmet and 15 the main wire which ends on the inside of the said helmet in the terminal 21. The conducting-wire 23 of the covered conductor 15 is insulated from the helmet by the non-conducting bushing 24, this being inclosed in the socket 19, upon which rests the compressing-piece 22 and the gland 18, any suitable packing being included in the space between the compressor and the bushing. The receiver 7 and transmitter 8, affixed within the helmet, are brought into the circuit by a wire leading from the terminal 21 through

both instruments, and from the last instrument—say the receiver—to the metal of the helmet, to which it is finally attached, and which thus serves as the earth-plate, being surrounded on all sides by the water. But one wire, 15, passing down to the diver, is absolutely essential, as the circuit on the land side can readily be completed by means of a short wire leading to a plate let down into the water, or an earth-plate; but for convenience I employ a bare wire, 16, to form the return-circuit, which may be twisted with the main wire round the pipe or tube T, and which may continue as far into the water as may be thought desirable. In some cases it will be found advantageous to carry it completely to the helmet H, or even to attach it thereto, in which case the resistance is reduced to a minimum. The battery which I have used consists of two or three cells made of rubber, with zinc and carbon for the elements in a sal-ammoniac solution, the form of carbon being that of a hollow cylinder surrounding the zinc.

Fig. 3 shows in diagram the arrangement of circuits. From one pole of the battery 3 the wire 15 leads down through the stuffing-box 17 to the transmitter 8, receiver 7, within the helmet H, and then to the substance of the helmet and the surrounding water, return-wire 16, telephones 7 and 8 on the land, then by wire 11 to the circuit-closing key 9, anvil *a*, and by the wire 14 to the other pole of the battery.

In the operation of this instrument, if the attendant wishes to speak with the diver, he takes the instrument from the hook at his side, and in grasping it presses a key, thus closing the battery-circuit. The diver can clearly hear anything that is said, even if his ear be not against the receiving-telephone. The key is depressed, maintaining the circuit closed as long as the conversation lasts. If the diver wishes to speak, he pulls the life-line L, and the attendant, taking up his instruments to listen, depresses the key, and in so doing throws on the battery, so that the diver has the power to state his wishes.

It will be observed that one pole of the battery 3 is marked *z*, to indicate the zinc element, and that one terminal of the telephone is also marked with the same letter. The purpose of this is to indicate that the receiving-telephones should in all cases be so connected up that the battery-current passing through their helices will tend to strengthen, instead of to weaken, their initial and permanent magnetism, and that this can readily be provided for in practice by marking one of the terminals of the telephone with some easily-understood mark, to indicate that pole of the battery which should be connected with the said terminal. By marking a given terminal—*z*, for example—it will be uniformly understood that the telephone must be so connected in circuit that the wire leading from the zinc element is to be united to that terminal.

It will also be understood that, although in

the foregoing description I have referred uniformly to the attendant and his telephones as being upon the land, my invention includes of course the same elements if located upon a ship or boat, as shown in Fig. 5.

5 In carrying out my invention I contemplate also its use between two or more divers while under water, as illustrated in Fig. 5. In this case I place the battery in a hermetically-sealed case, 60, attached to the person of one or of each of the divers by means of a belt, or otherwise, and the circuit-wires may enter the same gland on their helmets with the wires communicating with the attendant above.

15 I may, if I choose, arrange the telephones on the outside of the helmet, and connect them to the interior of the helmet, by means of orifices in the surface of the helmet or by air-tubes. This construction is illustrated in Figs. 12, 13, 20 and 14, Figs. 13 and 14 being sections on lines *x x* and *y y*, respectively, of Fig. 12. In these figures the receiver 7 and transmitter 8 are shown as supported outside the helmet H and communicating with the interior thereof by 25 suitable openings.

I do not limit myself to any special means of running the wire 15 between the attendant and the diver. Thus in Fig. 6 the wire 15 is shown as twisted around the life-line L, and in 30 Figs. 7 and 8 it is shown as forming a component part of the said life-line. In Fig. 9 the wire 15 is shown as separate from both the life-line L and the tube T, and in Figs. 10 and 11 it is shown as inclosed in the air-tube.

Other modifications may be made without 35 departing from the spirit of the invention.

Having now described my invention and its operation, I claim—

1. A system of telephonic communication for divers' use, comprising two or more helmets, a transmitting and a receiving telephone for each helmet, an independent transmitter and receiver above the water, a battery in a hermetically-closed case supported by the diver, and an electric circuit including said 45 telephones and battery, substantially as described.

2. A system of telephonic communication for divers' use, comprising a diver's helmet, transmitting and receiving telephones supported thereby, an independent transmitting and receiving telephone for use on shore, and a connecting circuit having one or both terminals in the metal of the helmet, substantially 55 as described.

3. The combination of the belt, the combination-telephone and supporting-hook therefor carried by said belt, and the battery and case also carried by said belt, substantially as 60 described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 30th day of June, 1886.

HAMMOND VINTON HAYES.

Witnesses:

THOS. D. LOCKWOOD,
GEO. WILLIS PIERCE.