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R. D. PARKER ET AL

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SUBMARINE CABLE TELEGRAPHY

Filed Oct. 8, 1925

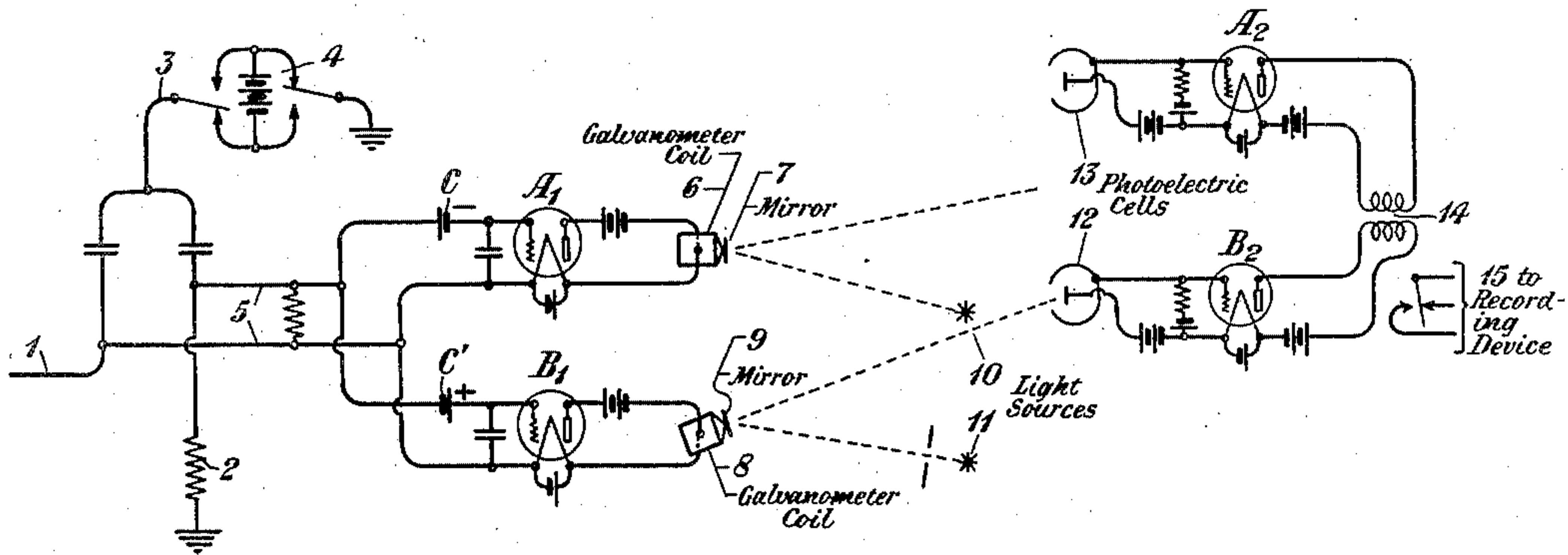


Fig. 1

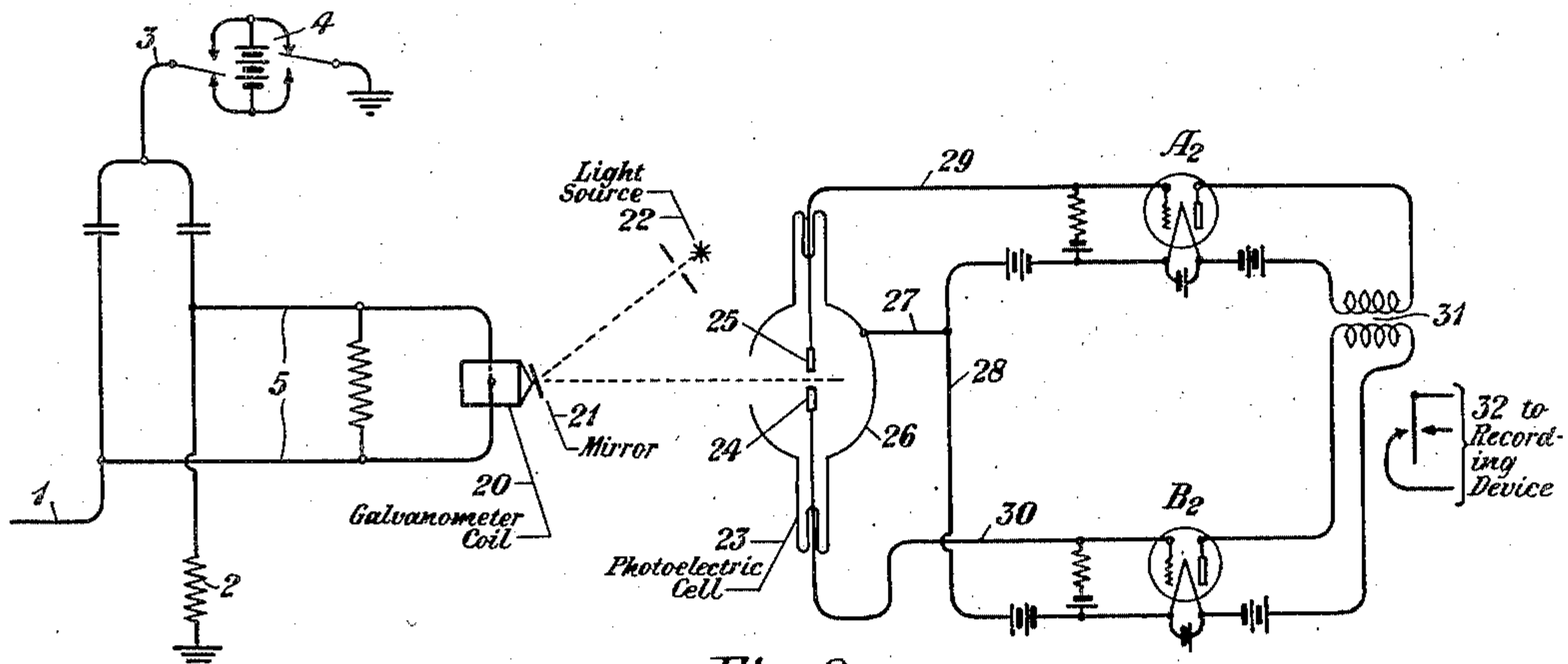


Fig. 2

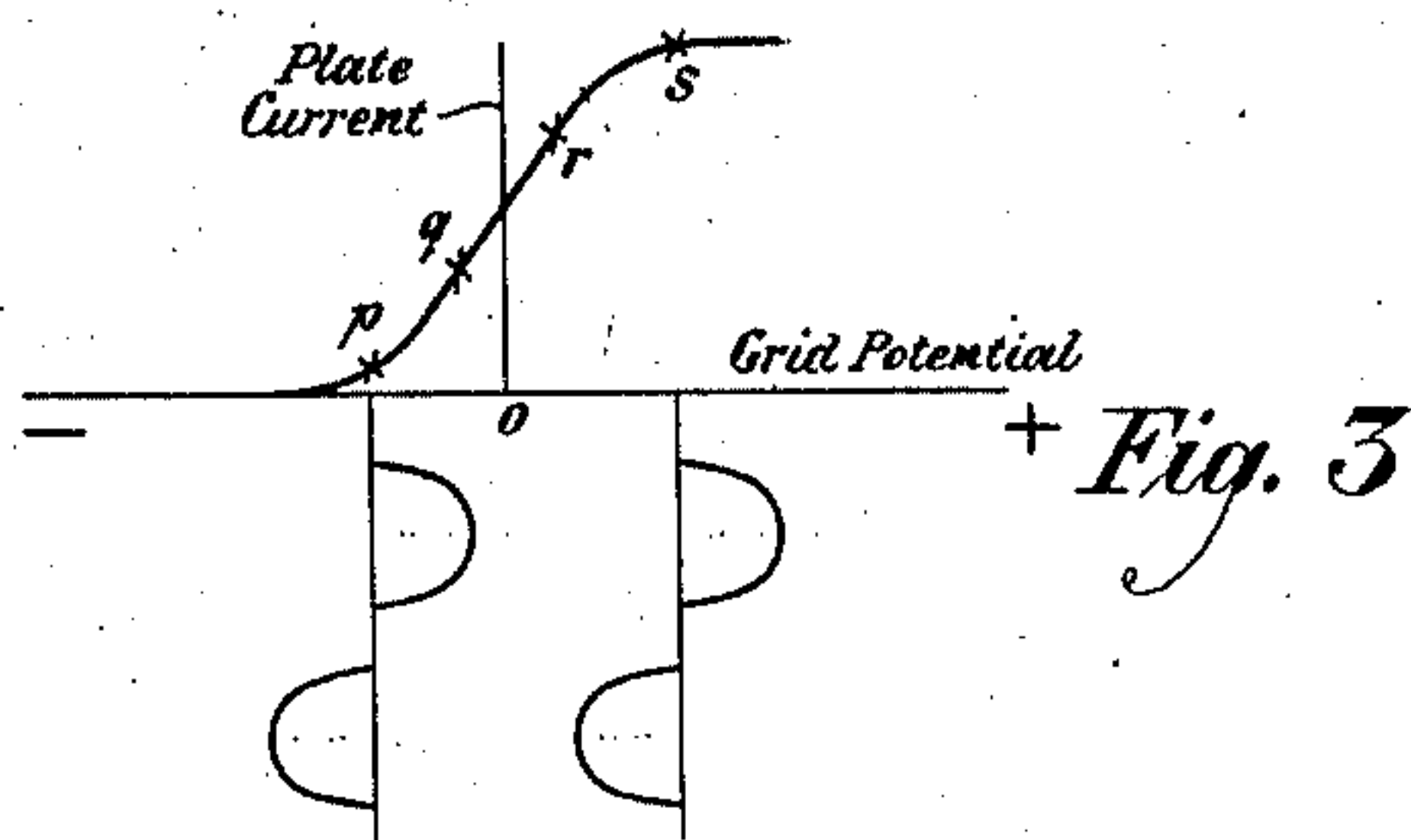


Fig. 3

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SUBMARINE-CABLE TELEGRAPHY.

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This invention relates to signaling system and more particularly to receiving arrangements for systems over which the signals are transmitted by means of positive, negative and zero impulses, such, for example, as submarine cable telegraph systems.

When signals are transmitted by means of positive, negative and zero impulses over a circuit such, for example, as a submarine cable telegraph circuit, the signals, by the time they reach the receiving station, are usually very weak and special types of amplifying and recording arrangements have to be provided thereat for their reception. It is one of the primary objects of this invention to provide improved arrangements for amplifying and receiving signals in systems of the above mentioned types. In the arrangements of the invention the incoming signals will operate one or more galvanometer coils which in turn will operate one or more mirrors to reflect one or more beams of light upon photo-electric cells. An alternative arrangement might utilize refracting means instead of reflecting means for the purpose of directing the light beams. The circuits including these photo-electric cells, or other radio sensitive cells, will operate a receiving device to record the signals. With this type of arrangement it will be seen that the primary moving element is a beam of light rather than an armature or other more weighty device. Accordingly, the weakness of the incoming currents will not be such a serious handicap to reception and signals much weaker than heretofore may readily be received. The arrangements of the invention also serve to improve the wave shape of the incoming signals and to eliminate the effects of interfering current. Other features and objects of the invention will appear more fully from the detailed description hereinafter given.

The invention may now be more fully understood from the following description together with the accompanying drawing, in Figures 1, 2 and 3 of which the invention and a modification thereof are illustrated. In Fig. 1 is shown a circuit diagram of one form of the invention, utilizing two galvanometers and two photo-electric cells, while in Fig. 2 is shown an arrangement utilizing only one galvanometer and one photo-electric

cell. Fig. 3 is a graphic illustration of certain of the principles of operation of the arrangements of Fig. 1.

In Fig. 1 is shown a transmission line 1, such as a submarine cable telegraph circuit over which messages are being transmitted by means of positive, negative and zero impulses. The line 1 is connected to a sending circuit 3 comprising the usual sending apparatus 4, and the usual artificial line 2 is also provided. A receiving circuit 5 is connected to the line 1. Connected in parallel with the receiving circuit 5 are two vacuum tube amplifiers A_1 and B_1 . In the output circuit of these amplifiers are the galvanometers 6 and 8. Mounted on each of these galvanometers are the mirrors 7 and 9 respectively. Light sources 10 and 11 are provided to throw beams of light on these mirrors which will cause a reflected beam to be cast toward the photo-electric cells 12 and 13. In the circuits connected to these photo-electric cells are amplifiers A_2 and B_2 and the windings of a receiving relay 14. This receiving relay 14 controls the contacts of circuits 15 which lead to a recording device such, for example, as a siphon recorder.

The amplifier A_1 has a negative bias on its grid by reason of having the battery C in its input circuit connected with its negative terminal to the grid. The amplifier B_1 has a positive bias on its grid by reason of having a battery C_1 in its input circuit connected with its positive terminal to the grid. By now referring to Fig. 3, it will be seen that when the incoming signal is zero, the plate current of amplifier A_1 is given by the ordinate of p , and the plate current of amplifier B_1 is given by the ordinate of r . When a positive impulse is received the plate current of A_1 jumps from p to q and back to p , while the plate current of B_1 , being already at a near saturation value r , cannot increase materially. When a negative impulse is received the plate current of B_1 jumps from r to s and back to r , while the plate current of A_1 , being already at a near zero value p , cannot decrease materially. Thus, we have amplifier A_1 responding to positive impulses and amplifier A_2 responding to negative impulses, and neither of the amplifiers responding to zero impulses.

In order to detect signals coming in at

high speeds, the mirror galvanometers 6, 7 and 8, 9 are placed in the output circuits of the amplifiers A_1 and B_1 . These galvanometers may be of the moving coil type or of some other suitable type. Accordingly, a positive impulse coming in over the line 1 will be amplified by the amplifier A_1 and will deflect the galvanometer 6. A negative impulse coming in over the line 1 will be amplified by the amplifier B_1 and will cause the deflection of the galvanometer 8. A zero impulse obviously would leave the galvanometers in their normal positions. Galvanometer 6 is shown in its normal position. In this position the reflected beam of light from the source 10 will not touch the photo-electric cell 13. The galvanometer 8, however, is shown in its deflected position due to an incoming impulse of negative polarity. This deflection of the galvanometer causes the light beam reflected from source 11 to fall on the cathode of the photo-electric cell 12. Accordingly, an incoming negative impulse will cause a light beam to fall on cell 12, an incoming positive impulse will cause a light beam to be reflected on cell 13, and zero impulses will cause no reflection of light on either of the cells. The reflection of the light beam on the sensitive element of the cell is to initiate or to increase the flow of electrons from the emitter to the receptor of the cell. These photo-electric currents thus generated by virtue of the positive signals in A_1 and the negative signals in B_1 , are then amplified by the amplifiers A_2 and B_2 respectively and transmitted to the windings of the relay 14. The armature of relay 14 will move to one contact for a positive incoming signal and to the other contact for a negative incoming signal, and will stand in the air when no signal is being received. The movements of the armature accordingly may operate a siphon recorder or any other suitable recording device.

In Fig. 2 is shown another arrangement of the invention in which only a single galvanometer 20 is included in the input circuit 5. This galvanometer will be deflected in one direction by positive incoming impulses and in the other direction by negative incoming impulses. Attached to the galvanometer 20 is the mirror 21, which will reflect the light beam from the source 22 to the photo-electric cell 23. The photo-electric cell 23 has two central sensitized cathodes 24 and 25. A negative battery is connected to each of these cathodes, as shown; the positive terminals of these batteries being connected by conductor 27 to the inner surface of the bulb, which is coated with metal except for a small circular area through which the light enters. This inner surface therefore acts as an anode and collects the electrons which are emitted from either cathode when it is illuminated, this

phenomenon being known as a photo-electric effect. Associated with each of the cathodes is a circuit comprising amplifiers such as A_2 and B_2 . In the output circuits of these amplifiers are the windings of a relay 31, similar to the receiving relay 14 heretofore described. Controlled by this relay are conductors 32, leading to a recording device. When a zero impulse is transmitted, the galvanometer will not move and the reflected beam of light will fall directly between the two cathodes 24 and 25. A positive impulse coming in will cause the galvanometer to be deflected upwardly so as to cause the reflected beam of light to fall on the cathode 25. This will transmit current through the circuit of amplifier A_2 and actuate the relay 31 to cause the recording of a positive impulse. An incoming negative impulse will cause the galvanometer 20 to be deflected so as to cause the reflected light beam to fall on the cathode 24 to set up a current flow in the circuit of amplifier B_2 to cause the relay 31 to operate to record this negative impulse.

While this invention has been described and illustrated in certain forms it is capable of other and different forms and arrangements within the spirit and scope of the appended claims.

What is claimed is:

1. In a signaling system, a receiving circuit into which are transmitted signaling impulses of different character, a galvanometer device in said circuit giving different deflections in accordance with said differing incoming signaling impulses, a light source, a reflector mounted on said galvanometer and moveable into different positions by said galvanometer deflections whereby the reflected beam of light from said source will assume different positions in accordance with said differing incoming signaling impulses, a photo-electric cell having a plurality of cathodes, and different signaling circuits controlled by each of said cathodes, said photo-electric cell being so positioned with respect to the reflected positions of said light beam that said different signaling circuits will be individually responsive to said different reflected positions of said light beam.

2. In a submarine cable telegraph system, a receiving circuit into which are transmitted signals of positive, negative and zero impulses, a galvanometer device in said circuit, the moveable element of said galvanometer being deflected in one direction for positive impulses, in another direction for negative impulses, and remaining normal for zero impulses, a light source, a reflector operated by the moving element of said galvanometer whereby the reflected beam of light from said source may be caused to assume different positions in accordance with said incoming signaling impulses of different character, a

photo-electric cell having a plurality of cathodes, individual amplifying circuits controlled by each of said cathodes, said cathodes being so positioned with respect to
5 the reflected positions of said light beam that said individual amplifying circuits will be responsive to different reflected positions of said light beam, and responsive means con-

trolled by said individual amplifying circuits.

In testimony whereof, we have signed our names to this specification this 7th day of October, 1925.

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