G. CONSTANTINESCO.

TRANSMISSION OF IMPULSIVE FORCES THROUGH LIQUIDS.

APPLICATION FILED JULY 23, 1917.

1,334,282. Patented Mar. 23, 1920.

4 SHEETS—SHEET 1.

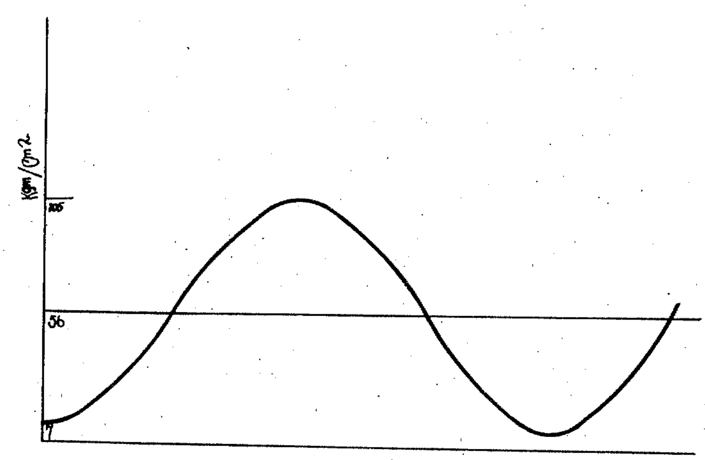

Fig. 1.

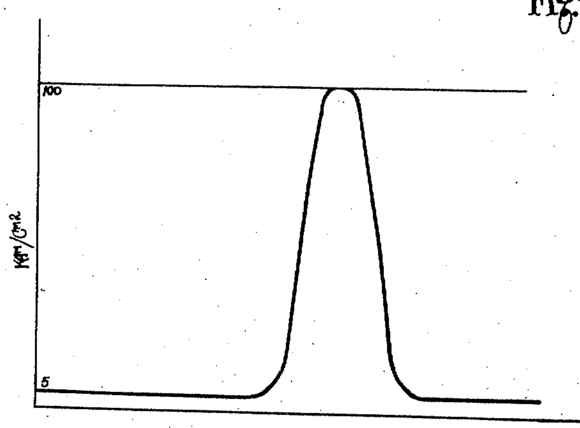

Fig. 2.

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by

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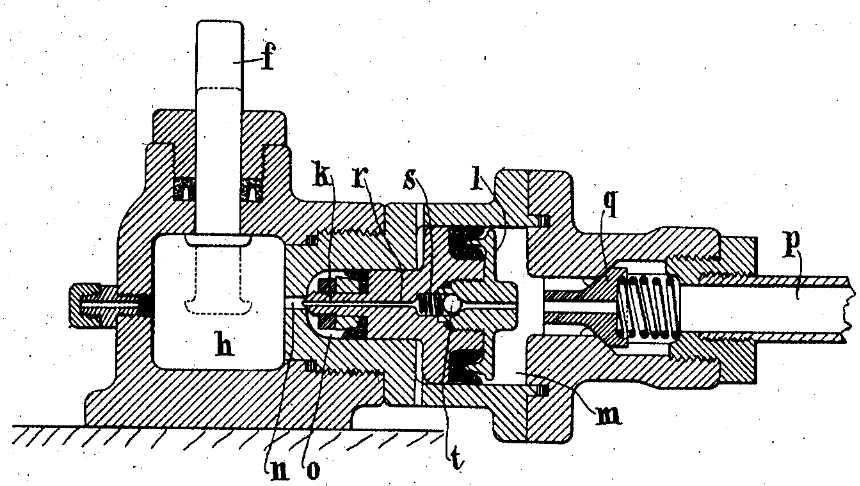

Fig. 4.

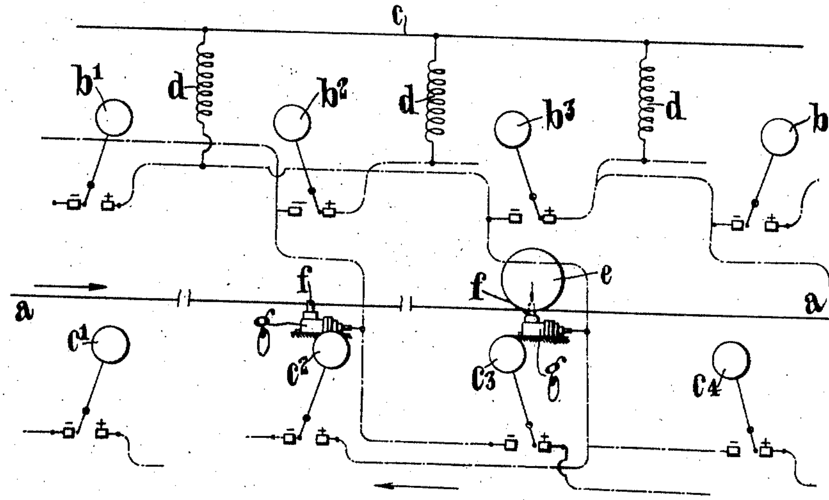

Fig. 3.

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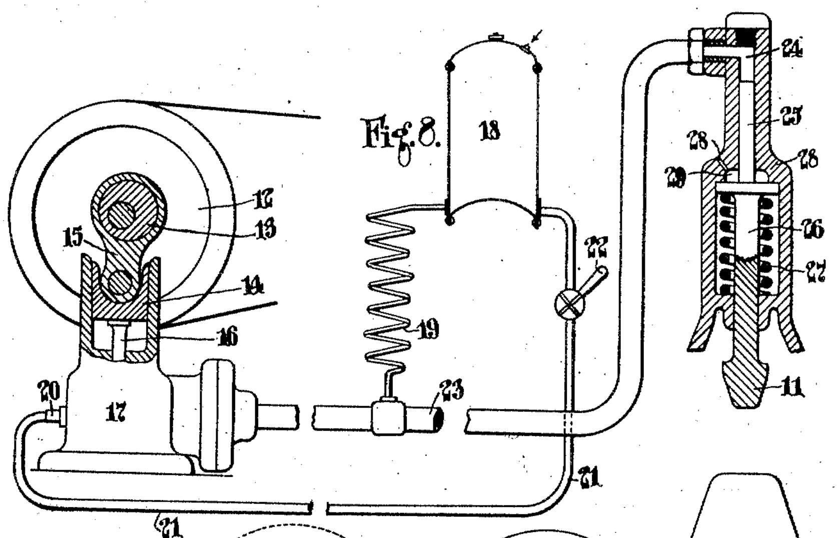

Fig. 8.

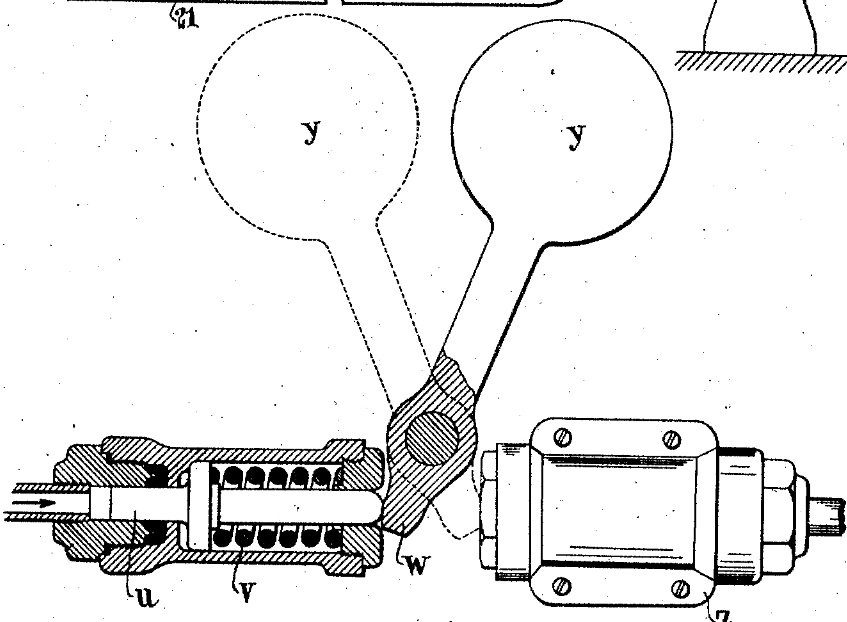

Fig. 5.

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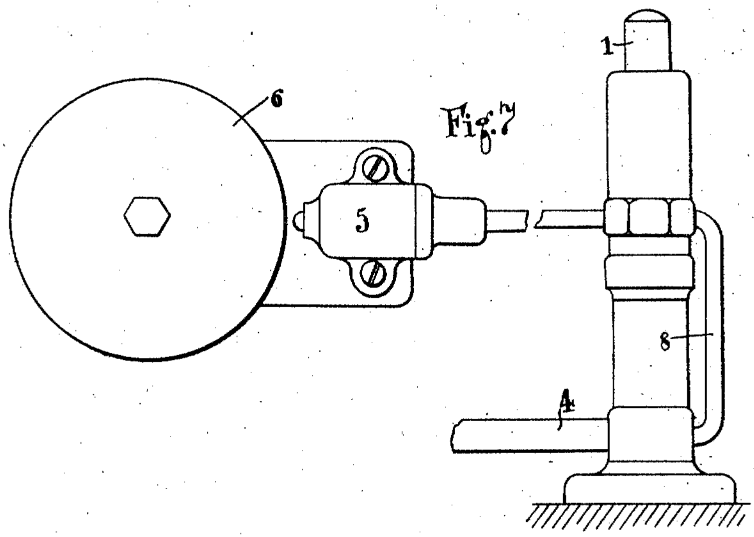

Fig. 7

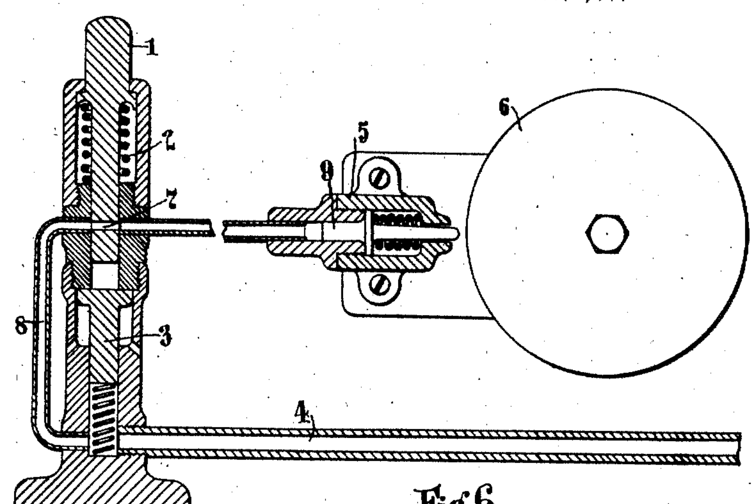

Fig. 6.

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by

Attorney

UNITED STATES PATENT OFFICE.

GOGU CONSTANTINESCO, OF ALPERTON, ENGLAND, ASSIGNOR OF ONE-HALF TO WALTER HADDON, OF LONDON, ENGLAND.

TRANSMISSION OF IMPULSIVE FORCES THROUGH LIQUIDS.

1,334,282. Specification of Letters Patent. **Patented Mar. 23, 1920.**

Application filed July 23, 1917. Serial No. 182,206.

To all whom it may concern:

Be it known that I, Gogu Constantinesco, a subject of the King of Great Britain and Ireland, residing at "Westoe," Stanley avenue, Alperton, in the county of Middlesex, England, have invented certain new and useful Improvements in the Transmission of Impulsive Forces Through Liquids, of which the following is a specification.

The present invention relates to the transmission of impulsive forces through liquids from one point to another.

In British Letters Patent No. 9,029 of 1913, there is described a method of transmitting power by wave motion in liquids by means of a series of periodic changes of volume and pressure traveling along a liquid column, and apparatus is therein shown and described for transmitting changes of volume and pressure of harmonic form.

Referring to the accompanying drawings:

Figure 1 is a diagram illustrating the type of pressure wave described in British Patent Specification No. 9,029 of 1913;

Fig. 2 is a diagram showing the type of wave produced according to the present invention;

Fig. 3 is a diagram showing the application of the invention to the operation of a railway signaling system;

Fig. 4 is a section of a suitable form of impulsive wave generator for use in the system;

Fig. 5 shows a signaling instrument adapted to be used in the railway signaling system illustrated;

Fig. 6 shows a ship's telegraph device in section, while

Fig. 7 is an elevation showing a similar ship's telegraph, one instrument being employed, say, on the bridge and the other in the engine room of a steamship;

Fig. 8 shows the application of the invention to the operation of a hammer.

The type of wave which we have heretofore generated by the method and apparatus described in the said Letters Patent is shown in Fig. 1 of the accompanying drawings, where the abscissæ of the curve represent distances from the source of energy and the ordinates represent the pressures at the different points along the pipe at any particular time.

The type of wave produced according to the present invention is diagrammatically illustrated in Fig. 2 in which there is a rapid rise of pressure above the mean pressure. The abscissæ of the curve represent as before the distances along the pipe from the source of energy while the ordinates represent the pressures at different points along the length of the pipe at any particular time. It will be seen from a comparison of the figures that in the first case a mean pressure of greater than half the amplitude of the pressure variation is required, while in the latter case the mean pressure need only be slightly above atmospheric pressure.

The invention is especially applicable to cases in which it is required to transmit considerable forces acting only during a very short time at a receiver situated at a distance from the generator.

It will be seen that in transmitting impulses according to this invention as in the case of the wave transmission described in our Letters Patent above mentioned, the transmission of the energy is not instantaneous but a time interval elapses between the generation of the wave at the generator and its reception at the receiver, this time being equal to the time which would be taken by the wave to travel from the generator to the receiver in the liquid considered.

It is extremely difficult to design a receiver to take up the whole of the energy of the forward traveling wave.

Should it happen that the energy of the wave is not entirely absorbed by the receiver there is danger that the wave is reflected back toward the generator and again reflected toward the receiver, thus giving a second impulse on the receiver piston, and it has been found that three or more such reflections may occur with the result that instead of one impulse on the receiver several impulses may be obtained from a single wave from the generator. It is, therefore, in most cases essential to destroy the reflected wave as soon as it starts back from the receiver. This may be effected as follows: Between the receiver and the transmission line we insert a check valve giving a free passage to the flow of liquid from the line toward the receiver, but considerable friction in the opposite direction. This may be effected by making a small permanent opening in the valve. The valve would close on its seat on the return of the wave from the receiver and the energy of the wave would be destroyed as the liquid passes through the small hole in the valve. The introduction of this reflected wave absorber alters completely the conditions of the liquid wave, and in apparatus we have tested with a 3 meter length of transmission line while without the absorber the amplitude of the second reflected wave as nearly 70 per cent. that of the first wave and a third reflected wave was of amplitude of 30 per cent. of that of the first wave, when the reflection absorber was inserted no trace of the reflected waves was noticeable.

For some practical applications it is practically always necessary to introduce a reflection absorber owing to the extreme difficulty of regulating the strength of the wave exactly in accordance with the work done by the receiver. Only in cases in which the line is extremely long and the loss due to friction considerable, is it possible to neglect the reflected wave which in such case is sufficiently damped and is extinguished before it again reaches the receiver.

In the application of the invention to railway signaling as illustrated in the example given in the Figs. 3, 4, 5, and in which there is diagrammatically represented a railway line *a* having on one side a series of signals b^1 b^2 b^3 b^4 for trains running in one direction, and on the other side a series of signals c^1 c^2 c^3 c^4 for trains running in the other direction. In the neighborhood of each pair of signals b^1 c^1, b^2 c^2, b^3 c^3, and b^4 c^4, there is provided a wave generator *g* shown in section in Fig. 4, adapted when the wheel of the train runs over it to send impulsive waves along liquid wave transmission lines connected to signal motors illustrated in Fig. 5 and arranged to operate certain of the signals according to the direction and position of the train on the line. Each of the signal motors is capable of operating a signal in either direction from the "line clear" position to the "danger" position, or from the "danger" position to the "line clear" position.

In the diagram shown in Fig. 3, assuming a train is moving from left to right in the direction of the arrow, and assuming that it has reached the position indicated by the wheel *e* opposite the signals b^3 c^3, before the wheel reached the instrument *g* at b^3 c^3, the signals b^3 b^4 were in the "line clear" position and the signals b^1 b^2 in the "danger" position while on the other side of the line the signals c^4 c^1 were in the "line clear" position and the signals c^2 c^3 in the "danger" position; on the train reaching the generator opposite b^3 c^3 the plunger *f* is actuated and sends an impulsive wave along the transmission line, as indicated, to the signals b^1 and b^3 and also to the signals c^2 and c^4.

The effect of the impulses thus sent to the signaling instruments is to move the signal b^3 from "line clear" to "danger" and to move the signal b^1 from "danger" to "line clear" so that two signals stand at "danger" in front of an overtaking train. On the other side of the line the effect of the wave sent is to put the signal c^2 from the "danger" position to the "line clear" position and to put the signal c^4 from the "line clear" position to the "danger" position. The signals c^3 c^4 shown in the "danger" position in the diagram should, in order to secure safety for the trains in both directions in the same line, be one block ahead of that illustrated. The arrangement of the connections, however, forms no part of the present invention as different systems of signaling may be employed using the impulsive impulses traveling along liquid columns.

Separate generators may be provided at the different signal stations for trains moving in the opposite direction to that above described, and the means for operating these devices may be so arranged that a train passing in one direction operates one set of generators while a train passing in the opposite direction operates another set of generators.

In the impulse generator illustrated in Fig. 4 there is provided a plunger *f* working in a chamber *h* and adapted to be actuated by a blow on its upper end. The diameter of the plunger may be about two centimeters, which will be suitable if the impulse is produced by a weight of three tons passing over the upper end of the plunger. The forcing in of the plunger will produce a pressure of about 1000 kilograms per square centimeter in the chamber *h*. The pressure in the chamber *h* acts on the end of a conical valve *k* having at its other end a piston *l* working in a chamber *m* of considerably greater diameter than the aperture *n* or intermediate chamber *o*. The chamber *m* is connected to the transmission line *p* through a wave absorbing device *q* intended to absorb the reflected waves, and liquid is fed into the wave transmission line at a mean pressure of about 5 kilograms per square centimeter. An aperture *r* is bored through the piston and valve *k*, *l*, and in an enlarged chamber *s* in the passage *r* there is provided a spring ball valve *t*.

The operation of this apparatus is as follows:—

On forcing down the plunger *f* the pressure rises in the chamber *h* to a very high value and this pressure acting on the ball *t* overcomes the pressure in the line so that the whole of the differential piston and valve *k*, *l*, moves forward; immediately the conical valve leaves its seat the pressure in the chamber h can act on a very much larger area of piston, acting over the whole of the diameter of the chamber o. The effect of this is that there is a very sudden increased movement of the differential piston so that a powerful impulsive wave is sent along the pipe p, the wave absorber q opening so that a wave of considerable intensity passes along the transmission line. This wave is led by the transmission line to those signal motors which it is desired to operate.

The signal motor illustrated at Fig. 5 consists of a plunger u pressed toward the generator by a spring v and having its rear end pressed against the short arm w of the signal y. An exactly similar motor z is provided to actuate the signal in the opposite direction. Should the whole of the energy of the wave not be taken up in actuating the signal there will be produced a liquid wave which will travel back along the transmission line until it reaches the wave absorber q which consists of a conical valve having an aperture therethrough. By this wave absorber the liquid wave is taken up and successive reflections and waves traveling indiscriminately up and down the pipe are prevented. This unidirectional wave absorber may be fitted with advantage at the receiver end, and preferably a number of them are fitted at intervals along the line.

In order to supply liquid to the line there is provided a suitable compensating tank containing liquid under the mean pressure of the transmission line. This tank feeds a pipe c which is connected to suitable points in the transmission line by pipes d which should be at a quarter wave length as explained and claimed in U. S. application Serial No. 246,396, filed July 23rd, 1918, and in order to put any generator out of operation all that is necessary is to connect the chamber h of that generator to the compensating line or tank; in this way the increase in the pressure in the chamber h due to the actuation of the plunger will be insufficient to send the impulse along the transmission line.

In the ship's telegraph device illustrated in Figs. 6 and 7 there is provided on the bridge and in the engine room an instrument illustrated in section in Fig. 6 and in outside elevation in Fig. 7. Each instrument comprises a hand plunger 1 normally pressed up by a spring 2. This hand plunger, when suddenly pressed down, as, for instance, by a blow with a hammer, comes in contact with a second plunger 3 pressed upward by a spring, and the downward movement of this plunger sends an impulse along the wave transmission line.

In order to avoid actuating the bell at the sending end when sending an impulse, the connection from the wave transmission line 4 below the plunger 3 to the motor 5 which actuates the bell passes through an aperture 7 in the plunger 1; the first movement downward of this plunger thus closes the passage 8 from the lower plunger 3 to the motor 5. When a signal is to be received, however, the plunger 1 is in its upper position and there is a free passage from the transmission line 4 through the passage 8 to the plunger 9 of the trigger motor, which is accordingly actuated to sound the bell 6.

In the form of the invention shown in Fig. 8, the hammer 11 is actuated by impulsive waves produced by a rotary generator 12. The generator comprises an eccentric 13 driving a piston 14 by means of a link 15. At the bottom of the piston there is provided a plunger 16 projecting into a chamber 17, in which the impulses are generated, constructed as illustrated in Fig. 4 and having within it a differential valve and piston such as k, l, Fig. 4. The effect of this is that the impulse is not sent to the transmission line by the generator 12 until the plunger has reached a certain point in its downward stroke, at which point the sudden impulse is transmitted to the line. There is provided a compensating tank 18 containing liquid with air above it at a pressure of, say, 5 kilograms per square centimeter. This tank is connnected by a pipe 19 of small bore to the trasmission line, and there is also provided from the outlet 20 from the chamber h a pipe 21 having a cock 22 and leading also to the compensating tank 18. When the cock 22 is open the pressure in the chamber h will not be sufficient to send an impulse along the line. The transmission line 23 is connected to the upper end of a chamber 24 in which works a plunger 25 attached to the hammer 26. This hammer is pressed upward by a spring 27, and breathing holes 28 are provided from the chamber 29 above the hammer. A wave absorber may be fitted to the generator, and, if desired, also at the entrance to the chamber 24.

Having now fully described and ascertained my said invention and the manner in which it is to be performed, I declare that what I claim is:—

1. A system of transmitting an impulse through a liquid column comprising: a container for a column of liquid, means for suddenly and violently impressing a change of volume in the liquid at one end of said column and thereafter allowing the pressure to fall to normal to thereby create an impulsive wave that travels through the liquid column, and means connected with said container for receiving and utilizing the energy of the wave thus produced.

2. A system of transmitting an impulse through a liquid column comprising: a container for a column of liquid, means for

suddenly and violently impressing a change of volume in the liquid at one end of said column and thereafter allowing the pressure to fall to normal to thereby create an impulsive wave that travels through the liquid column, means connected with said container for receiving and utilizing the energy of the wave thus produced, and means for absorbing the energy of waves reflected from said receiving and utilizing means.

In testimony whereof I have signed my name to this specification.

GOGU CONSTANTINESCO.