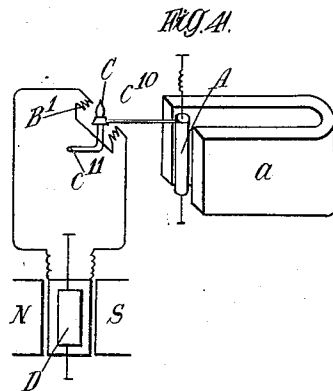
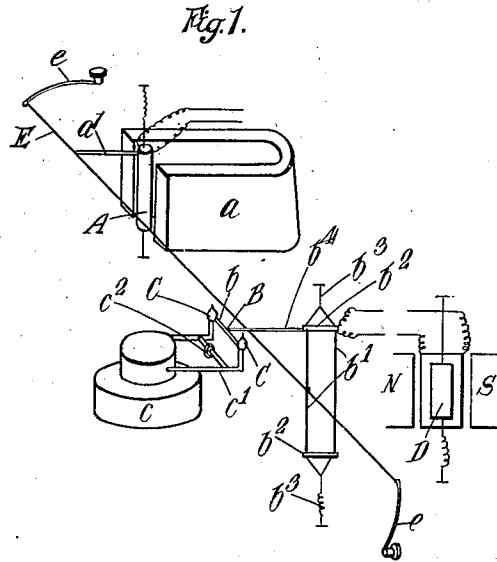
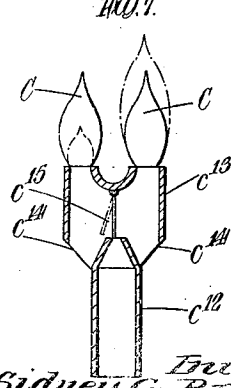
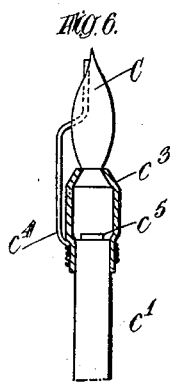
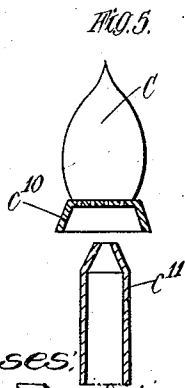
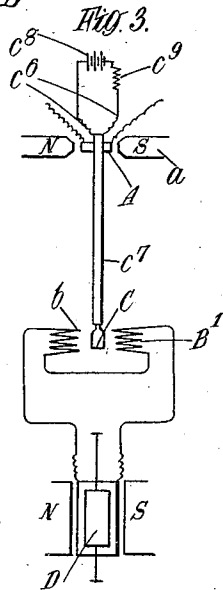
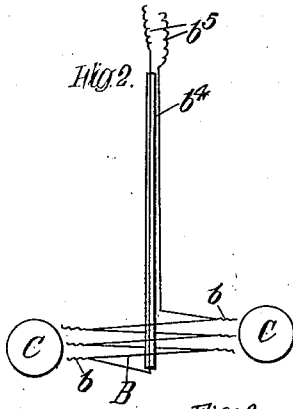


S. G. BROWN.
TELEGRAPHIC RELAY.
APPLICATION FILED AUG. 29, 1912.

1,058,541.

Patented Apr. 8, 1913.

2 SHEETS-SHEET 1.



Witnesses:
Edward F. White
[Signature]

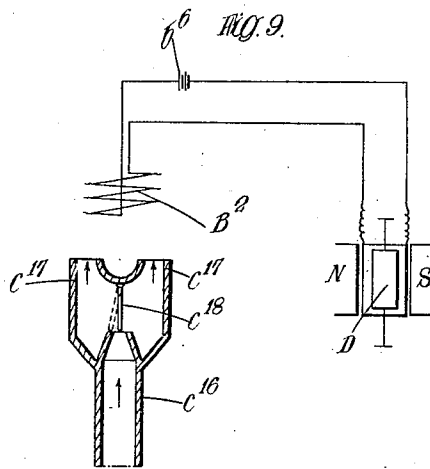
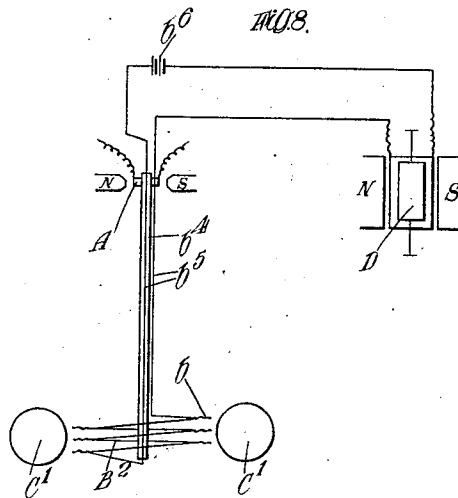
Inventor
Sidney G. Brown
by [Signature]
Atty.

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2 SHEETS—SHEET 2.



Witnesses:
H. C. McCartney
C. H. Miller

Inventor
Sidney George Brown
by *Amos L. Morris*
Attorney

UNITED STATES PATENT OFFICE.

SIDNEY GEORGE BROWN, OF LONDON, ENGLAND.

TELEGRAPHIC RELAY.

1,058,541.

Specification of Letters Patent.

Patented Apr. 8, 1913.

Application filed August 29, 1912. Serial No. 717,765.

To all whom it may concern:

Be it known that I, SIDNEY GEORGE BROWN, a subject of the King of Great Britain, residing at 4 Great Winchester street, in the city and county of London, England, have invented certain new and useful Improvements in Telegraphic Relays, of which the following is a specification.

This invention relates to telegraphic relays for use especially with submarine cables and provides a simple and readily adjustable type of apparatus which greatly magnifies the impulses received from the cable and is sensitive to minute changes of current. According to my invention the relay currents are produced by means of a small thermo-electric couple the junctions of which are subjected to variations of temperature under the control of the currents in the cable circuit. In one arrangement the two junctions of the couple are balanced between two sources of heat, preferably small flames, in such a manner that a change of position of the couple (which may be carried on a swinging arm controlled by the cable circuit) or an alteration of the flames causes a large difference of temperature to be set up between the junctions, a current being thus generated which operates a syphon or other recorder in the relay circuit. A single flame or other source of heat may also be used, placed between the junctions, and either the couple may be controlled by the cable currents or the heat source moved or otherwise varied. I may also use the reverse method of maintaining the junctions normally hot and applying a variable means of cooling, such as small jets of cool air into which one or other of the junctions may move under the control of the cable currents.

In order that my invention may be clearly understood and readily carried into effect I will now proceed to describe the same more fully with reference to the accompanying drawings in which:—

Figure 1 is a general diagrammatic view, shown in perspective, of an arrangement of receiving and recording apparatus embodying one form of my invention. Figs. 2, 3, 4, and 5 are diagrams illustrating three modifications of the relay. Fig. 6 shows a device for obtaining a small steady flame from methylated spirit or other light liquid fuel. Fig. 7 shows a method of controlling two flames to produce differential variable heat-

ing of the junctions, and Figs. 8 and 9 show modifications for use with cooling jets.

A is the receiving coil mounted between the poles of the magnet *a* and placed in the cable circuit.

B is the thermo-electric couple.

C is the source of heat for the junctions *b* of the couple.

D is the recorder, of any suitable description, placed in the circuit of the thermo-electric couple.

In the arrangement shown diagrammatically in Fig. 1, the receiving coil A controls the movements of the thermo-electric couple B through an arm *a'* connected to a fiber E stretched between light springs *e*, which are adjustable in strength and position. This stretched fiber is attached to a very light frame composed of two fibers *b'* connecting small aluminum plates *b²* which are suspended from a fixed part of the apparatus by the fine wires *b³* at the top and bottom. On one of the plates *b²* is an arm *b⁴* carrying the couple B, the arm being in the form of a fine glass tube (of siphon glass) carrying the wires connecting the couple to the recorder D. The fiber E is attached to the middle of one of the frame fibers *b'* and any swinging movement of the arm *a'* of the receiving coil causes the fiber E to move longitudinally and transmit the motion through the light fiber frame and arm *b⁴* to the couple B. The couple B may, however, be carried directly by an arm on the coil A.

The source of heat C for the couple consists of two small flames slightly farther apart than the junctions *b* so that the latter are normally just outside the surfaces of the flames and any movement of the couple due to the swinging of the arm *b⁴* plunges one or other of the junctions into the border of its adjacent flame, while the opposite junction moves away from its flame into a somewhat cooler zone. The heating flames are obtained from the spirit lamp *c* carrying the two wick tubes *c'* and accurate adjustment of the flames may be obtained by springing apart the tubes *c'*. These are provided with the transverse screw connection *c²* having a small milled head or other device which is turned to force the tubes apart, or to allow them to approach each other, until the distance between the flames C is adjusted to give the best result.

All the moving parts of the relay are

made as light as possible by using siphon glass tubes. (preferably about $\frac{3}{4}$ " in length) for the arms and fibers for the connections so that the cable currents have only a very small mass to move. The lag of the relay is reduced to a minimum for this reason and also for the reason that the thermo-electric junctions are so small that they respond almost instantly to the large changes of temperature dependent on their movements.

The lamp employed may be supplied with absolute alcohol in order to obtain a steady flame, or ordinary methylated spirit or other more or less impure light fuel may be used if burned as a vapor. To allow of the use of impure spirit without affecting the steadiness of the flame I may provide the end of the wick tube c' with a simple vaporizing device such as is shown in Fig. 6. This consists of a small chamber c^3 carrying a copper spiral c^4 the end of which extends up into the flame C. The wick c^5 is shown just projecting from the end of the tube c' and the copper wire conducts sufficient heat down to the tube to vaporize the spirit and fill the chamber c^3 . Spitting caused by water or other impurity is by this reason avoided and the flame remains steady.

Fig. 2 shows in detail to a larger scale a method of mounting a number of couples B upon the arm b^4 or an equivalent arm on the receiving coil A of Fig. 1. The platinum leading wires b^5 pass one through the bore of the fine tube constituting the arm and the other along the surface. The thermo elements may be of platinum and platinum iridium (20% iridium) wire of about .001" diameter, fused on opposite sides of the tube b^4 and united at their ends. Flat flames C may be employed if preferred, in order to provide for a substantial number of thermo-electric couples side by side.

In Fig. 3 the heating element C is in the form of an electrically heated filament, leading wires c^6 passing along the swinging arm c^7 (shown in this illustration as carried directly on the receiving coil A) and connecting the filament with the battery c^8 . An adjustable resistance c^9 may be placed in the circuit to regulate the temperature of the filament C. The thermo-pile B', composed of a series of couples, is stationary and the movement of the heated filament between the two sides of the thermo-pile produces the relay currents which affect the recorder D.

In Fig. 4 the arrangement is broadly similar to Fig. 3, but instead of the arm c^7 carrying a heating filament it carries a small gauze or perforated hood c^{10} , situated immediately over the end of a gas jet c^{11} as shown in detail in Fig. 5. The gas is not ignited until it passes through the hood c^{10} so that the flame C is separated from the jet by the hood and any change in position of

the latter alters the position of the flame. The flame is therefore moved to one side or the other by the impulses affecting the coil A and the thermo-pile, which just clears the flame in its normal position, is unequally heated at each impulse. In both Figs. 3 and 4 the swinging arm c^7 may be controlled by the stretched fiber and frame device of Fig. 1.

In Fig. 7 the heating element C is composed of two flames as in the arrangement first described, but instead of moving the couple the flames are controlled so as to vary their height. For this purpose a Bunsen burner is used comprising a gas jet c^{12} over which is the double burner c^{13} having air holes c^{14} . Immediately over the gas jet is a mica or other very light swinging plate c^{15} which deflects the flow of gas to one side or the other as it swings. In its normal central position the gas flows equally to the two wings of the burner, but any movement of the plate c^{15} partly interrupts the flow of gas to the side to which the plate swings and causes most of the gas to be deflected to the other side. One flame is then considerably enlarged and the other shortened, as shown by the dotted lines, and the thermo-electric couple which has its terminals just outside the flames when the latter are of equal size would then have one terminal within the border of the large flame and the other at some distance from the smaller flame. If the swinging plate c^{15} is placed under the control of the cable circuit by connecting it to an arm on the receiving coil or by any other convenient means, unequal heating of the terminals of the couple would take place at each impulse received from the cable.

I may arrange the relay so that one only of the junctions of the couple or one side only of the thermopile is subjected to variations of temperature. In any case the momentary differential heating of the junctions is sufficient to produce a current in the relay circuit greatly in excess of that necessary to move the operative parts under the control of the cable circuit. In the reverse method, in which the couple is maintained normally at a higher temperature than its surroundings, the couple may as shown in Fig. 8 be carried on an arm having wires leading from a battery b^9 maintaining the junctions b of the couple B at a high temperature, two jets C' of cool air being placed on opposite sides so that movement of the couple due to cable impulses plunges one or other of the heated junctions b into the adjacent air jet. Or I may use a deflecting device similar to that shown in Fig. 7 for varying cooling air jets instead of flames. This is illustrated in Fig. 9, in which the jet tube c^{16} is supplied with cooled air which passes through the branch tubes c^{17} at variable rates depending on the position of the

small swinging plate c^{15} , the action of which is similar to that of the plate c^{15} in the device shown in Fig. 7.

What I claim and desire to secure by Letters Patent of the United States is:—

1. In a telegraphic relay, a thermo-electric couple in the relay circuit, an independent heating element, and mechanical means, controlled by the cable circuit, for varying the heating effect of the said element on the couple at each cable impulse.
2. In a telegraphic relay, a thermo-electric couple in the relay circuit, a flame heating element and means, controlled by the cable circuit, for varying differentially the heating effect of the flame element on the said couple.
3. In a telegraphic relay, a thermo-electric couple in the relay circuit, a flame heating element and means, controlled by the cable circuit, for giving intermittent relative movement to the couple and the flame element.
4. In a telegraphic relay, a thermo-electric couple in the relay circuit, a flame heating element and means, controlled by the cable circuit, for plunging intermittently a junction of the couple into the flame.
5. In a telegraphic relay, a thermo-electric

couple in the relay circuit, a flame heating element comprising two flames and means, controlled by the cable circuit, for varying differentially the heating effect of the two flames upon the two junctions of the said couple.

6. In a telegraphic relay, the combination with a swinging arm under the control of the cable circuit, of a thermo-electric couple in the relay circuit and a heating element, one of which is carried on the said arm, the oscillations of which arm cause differential variations in the heating of the thermo-electric junctions.

7. In a telegraphic relay, a swinging arm under the control of the cable circuit, a thermo-electric couple in the relay circuit, mounted upon the said arm with its two junctions at opposite sides, and a flame element comprising two flames located just outside the two thermo-electric junctions in normal position.

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

SIDNEY GEORGE BROWN.

Witnesses:

T. SELBY WARDLE,
W. I. SKERTEN.