

Nov. 15, 1932.

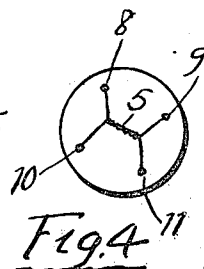
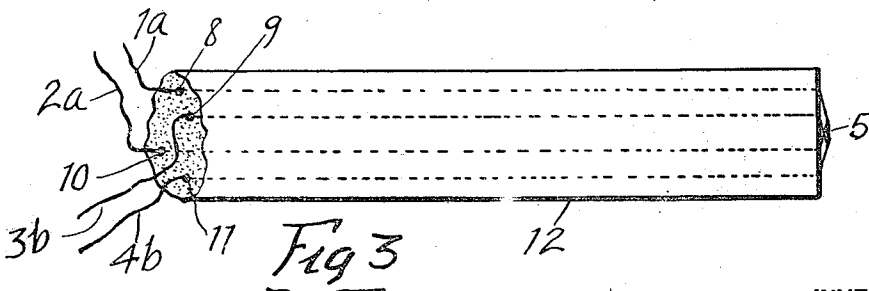
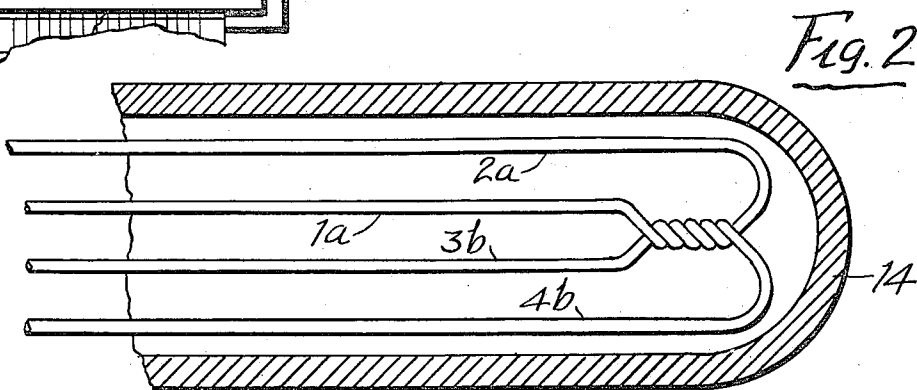
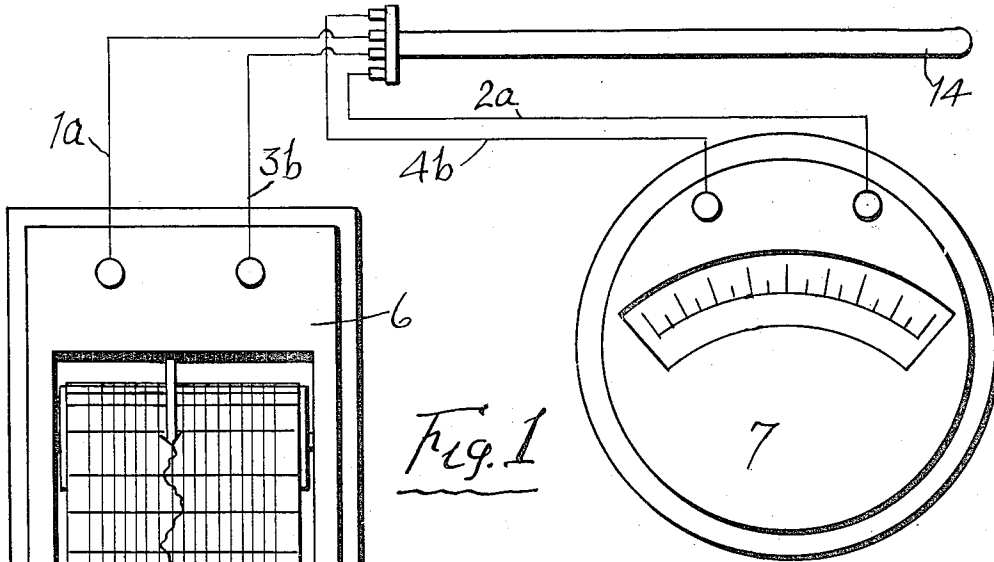
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1,887,827

THERMOCOUPLE AND ITS ELECTRICAL CONNECTION

Filed March 22, 1929

2 Sheets-Sheet 1



INVENTOR

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Nov. 15, 1932.

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THERMOCOUPLE AND ITS ELECTRICAL CONNECTION

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2 Sheets-Sheet 2

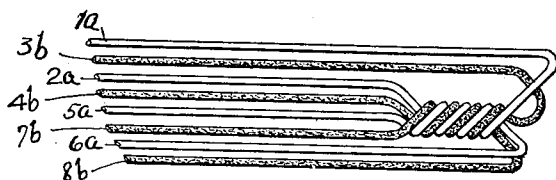


Fig. 5

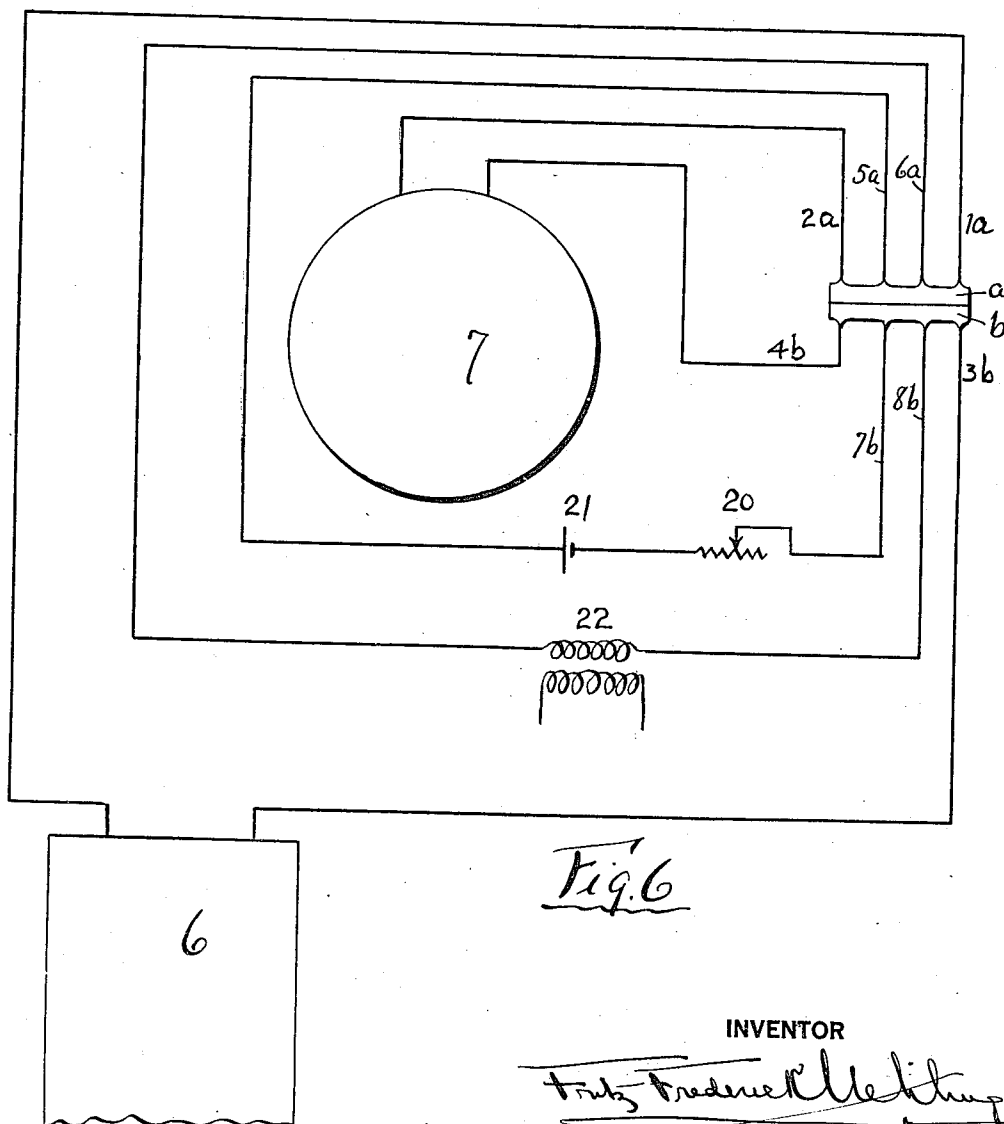


Fig. 6

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THERMOCOUPLE AND ITS ELECTRICAL CONNECTION

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My invention relates to a specially designed thermo-junction for use in combination with an indicating galvanometer and a novel recording galvanometer for recording the flow of current from a thermo-couple, the details of which galvanometer are fully described in my prior patent, Number 1,727,494.

In the particular recording galvanometer referred to the pen mechanism is actuated by a circuit, part of the current through which is intermittently shunted through the galvanometer and the thermo-junction. The purpose of this invention is therefore to provide a circuit which includes the thermo-junction and an indicating galvanometer, the electric flow through which is dependent upon the electro-motive force of the junction, and is independent of any effect due to the electric flow through the circuit which includes the same couple and the recording galvanometer.

Figure 1 illustrates the thermo-junction electrically connected with the recording galvanometer and the indicating galvanometer.

Figure 2 illustrates the thermo-junction and a protecting tube therefor, the latter in cross section.

Figures 3 and 4 illustrate a special form of the thermo-junction, Figure 4 being an end view of Figure 3.

Figure 5 illustrates a thermo-junction with eight leads, the four positive leads are shown stippled while the four negative leads of which are shown plain.

Figure 6 shows another design of thermo-junction with four independent negative leads and four independent positive leads constituting four pairs of leads, each pair included in a circuit entirely independent of the remaining pairs of leads.

In the recording galvanometer described in my prior patent, Number 1,727,494, there is a resistance which is included in the circuit with the thermo-couple and the galvanometer. The same resistance is also included in one or more independent circuits which do not include the galvanometer or the thermo-couple. It therefore follows that an electric flow through any one of the independent circuits would cause a drop across the resistance

which drop would affect the flow through the galvanometer as caused by the couple. This condition is essential to the satisfactory operation of this particular type of recording galvanometer. On the other hand if an indicating galvanometer were connected with the same couple in the usual way, it too would be deflected in one direction or another independently of the electro-motive force of the couple, as caused by the drop across the resistance in the manner already referred to. In order to eliminate this effect on an indicating galvanometer when used in conjunction with such a recording galvanometer, I provide a thermo-junction of the novel form herein described.

A recording galvanometer 6, Figure 1, is of the type described in the prior patent referred to, and is connected to measure the electro-motive force from a junction 5, Figure 2, which junction is located in a protecting tube or casing 14. An indicating galvanometer 7, Figure 1, is connected to measure the electro-motive force from the same junction. The junction may consist of two wires of different composition, twisted or welded together to form a thermo-junction which upon the application of heat will create an electro-motive force. The two wires of the particular thermo-junction referred to are so connected that the two ends of each wire, 1a and 2a, and 3b and 4b respectively, Figure 2, will extend from the junction to form two independent pairs of leads, one pair, 1a and 3b, for the recording galvanometer 6 and the other pair, 2a and 4b, for the indicating galvanometer 7. The circuit which includes the thermo-junction 5, leads 1a and 3b and the recording galvanometer 6 is therefore quite independent of the circuit which includes the thermo-junction, the leads 2a and 4b and the indicating galvanometer 7. It therefore follows that any flow through the circuit which includes the recording galvanometer and which may be quite independent of the flow caused by the junction (as described in my prior patent) will in no way affect the flow through the circuit which includes the indicating galvanometer, said

flow being entirely dependent upon the electro-motive force of the junction itself.

A thermo-junction with four leads as above described may be arranged in a multiplicity of ways, one which has particular merit is illustrated in Figures 3 and 4. The four ends of the two wires which are joined at a given point to form the junction extend through four small holes or channels 8, 9, 10 and 11, through the length of a piece of porcelain or other insulating material 12 as illustrated. The couple or junction 5 is thus held in a fixed position at the end of the porcelain and may, if desired, be protected by cover not shown.

Although this thermo-junction is primarily designed to facilitate the use of an indicating galvanometer in combination with the particular type of recording galvanometer above referred to, it is obvious that a four poled junction of this kind may have numerous other applications in which the junction forms part of two circuits, the flow through each of which being quite independent of the flow through the other. Furthermore it is obvious that although I have illustrated, in Figure 2, a junction with only four leads, any number of leads may extend from the couple so as to provide a multiplicity of circuits, one independent of the other as illustrated in Figures 5 and 6.

The thermo-junction as illustrated in Figure 5 consists, for example, of two positive thermo-couple elements, each element being in the form of a wire, and two negative elements, said negative elements being also in the form of a wire. These wires are twisted together in a region between their extremities as illustrated, thereby providing a thermo-junction with four negative and four positive leads, each lead extending directly from the junction itself. Each pair of leads may be included in an independent circuit. The current flowing through any one pair or more of the leads may be influenced by external means without in any way affecting the current flowing through any of the remaining pairs of leads. The obvious reason for the independence of the current flowing through any one pair of leads lies in the fact that none of the other leads in any way form part of the circuit through said pair of leads.

Another form of thermo-junction which perhaps more clearly illustrates the purpose of this invention is shown in Figure 6. One element of this junction is represented by *a* and the other element by *b*. It is obvious that the electro-motive force of the junction may be measured by the indicating galvanometer 7 through the leads 2*a* and 4*b* and that simultaneously this electro-motive force may be graphically recorded by the recording galvanometer 6 when connected with the elements *a* and *b* through the leads 1*a* and 3*b*. Furthermore another circuit which includes

the thermo-junction may also include in that circuit means for changing the flow through the circuit, as for example, a transformer 22 which, as illustrated, is connected with the junction through leads 6*a* and 8*b*. The primary coil of the transformer may be connected with some source of alternating current thereby inducing an alternating current in the secondary coil of the transformer which is included in the circuit with the leads 6*a* and 8*b*. The point of importance is that any change in the current flow through the circuit which includes the leads 6*a* and 8*b* as caused by the transformer 22 will in no way create any measurable influence on the remaining circuits which include the junction. Similarly a fourth circuit which includes a battery 21 and an adjustable rheostat 20 which are connected with the couple through leads 5*a* and 7*b* will also have no measurable effect on the deflection of the indicating galvanometer 7. In other words the adjustable rheostat 20 may be adjusted from one extreme to the other while simultaneously the indicating galvanometer 7 will measure the true electro-motive force as created by the junction alone.

As previously stated and as described in my prior patent above referred to, the current which flows through a circuit which includes the galvanometer and the thermo-junction in said patent is spasmodically influenced by the auxiliary circuit which insures contact between the needle of the galvanometer and its respective contact points as covered by said patent. In other words, as previously stated, without a thermo-junction as herein described, an indicating galvanometer could not be used in conjunction with that particular type of recorder described in said patent.

Although the herein described junction was particularly designed to simultaneously actuate an indicating galvanometer and the particular recording galvanometer described in my prior patent, it is obvious that it may have many applications where influences other than that of the temperature of the junction may be brought to bear on one or more of the circuits which include the junction.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a device of the class described, the combination with a wire having two ends, of a second wire having two ends, a thermo-junction made by joining the wires at a point between their respective ends, an electric circuit which includes the junction, that part of the first wire between the junction and one of its ends, and that part of the second wire between the junction and one of its ends, and a second circuit which includes the junction, that part of the first wire between the junc-

tion and the other of its ends, and that part of the second wire between the junction and the other of its ends.

2. In a device of the class described, the combination with a piece of metal, of a second piece of metal, a thermo-junction formed by fastening the two pieces of metal together, an electrical conductor from the first piece of metal, a second electrical conductor from the first piece of metal, a third electrical conductor from the second piece of metal, a fourth electrical conductor from the second piece of metal, an electric circuit which includes the junction, the first conductor and the third conductor, and a second electric circuit which includes the junction, the second conductor and the fourth conductor.

3. In a device of the class described, the combination with a thermo-junction, of a multiplicity of positive leads from the junction, a multiplicity of negative leads from the junction, and a multiplicity of electric circuits each of which includes the junction and a pair of leads.

4. A method for including a single thermo-junction in each of a multiplicity of electric circuits so that the effect on the flow through any one of the circuits, as caused by any means other than the junction, will not affect the flow through the other circuits, said method consisting in connecting the junction into each circuit by means of a separate lead from the positive pole of the junction and a separate lead from the negative pole of the junction.

5. In a device of the class described, the combination with a multiplicity of wires of a given composition, of a multiplicity of wires of a different composition, an electrical connection through all of the wires at a point between their respective ends, and a multiplicity of circuits each including the electrical connection, and one end of one of the wires of one composition, and one end of one of the wires of the other composition.

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