No. 705,187. Patented July 22, 1902.

A. ZELENY.

MULTIPLEX ELECTRIC THERMOMETER.

Application filed Jan. 20, 1902.)

(No Model.) 3 Sheets—Sheet 1.

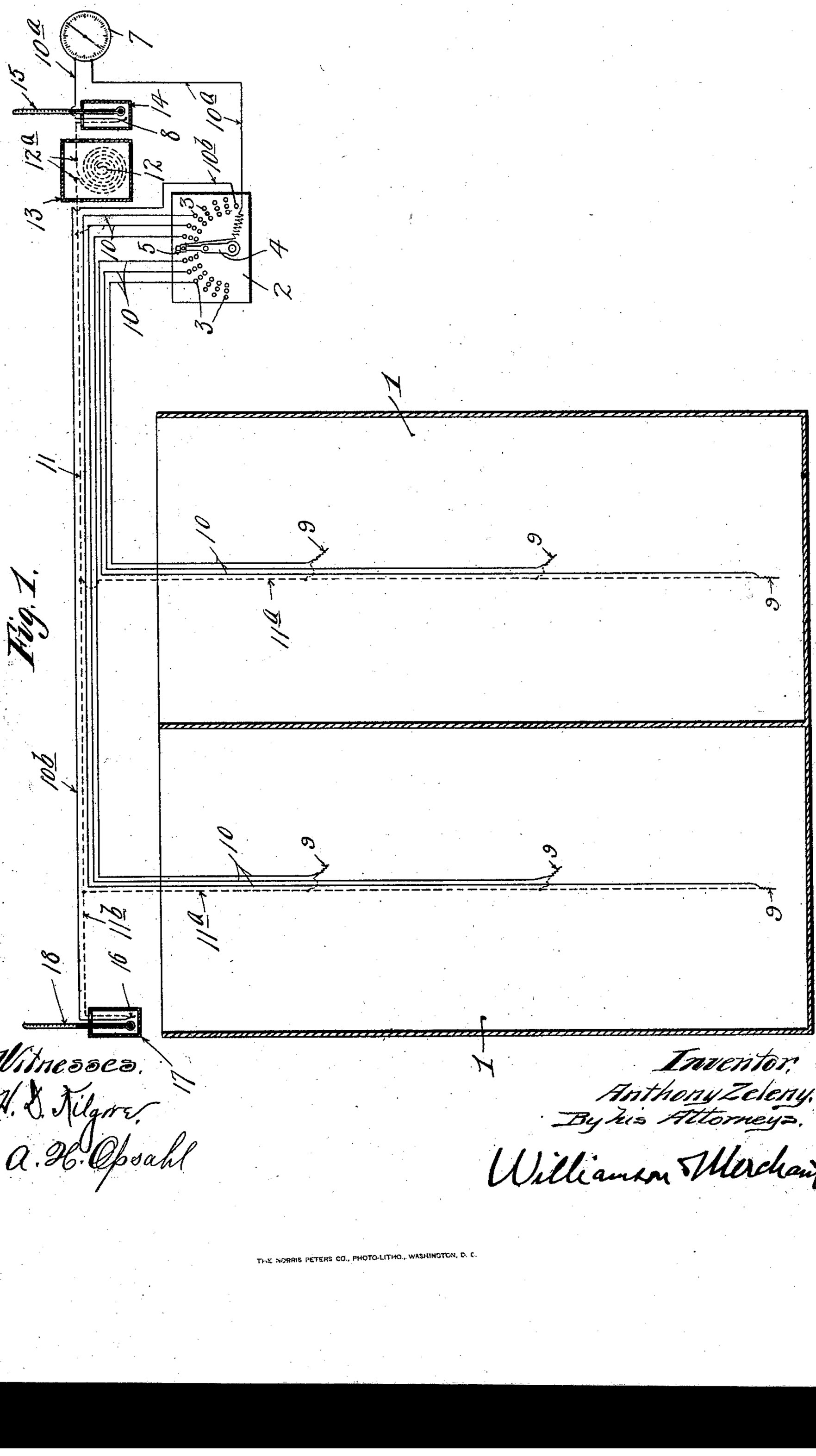

Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

Fig. 2.

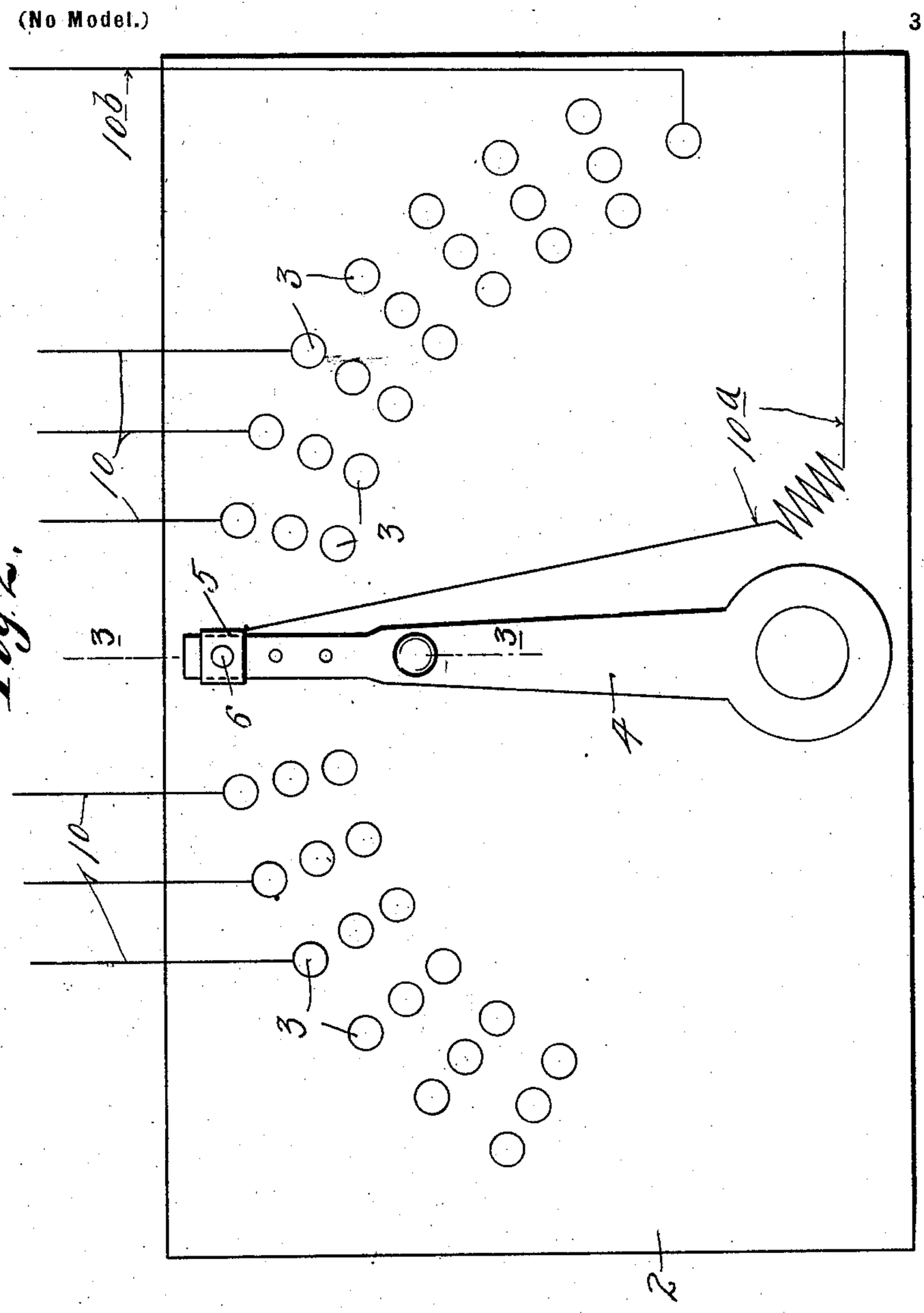
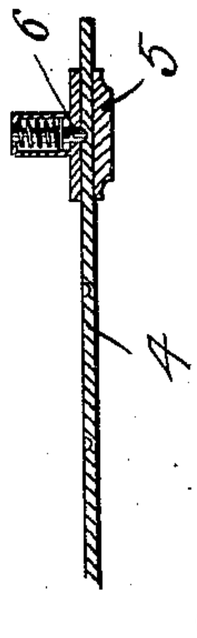


Fig. 3.



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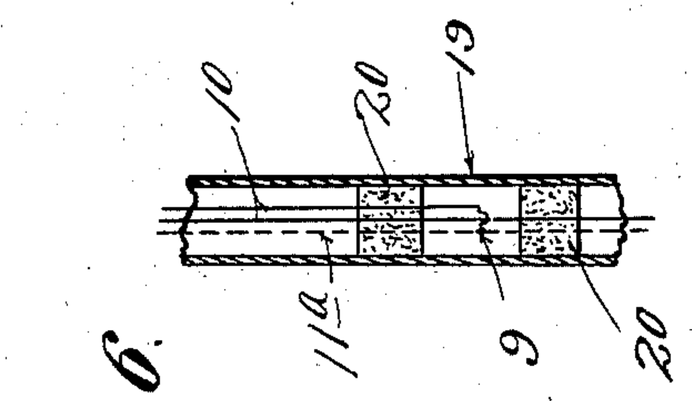

Fig. 6.

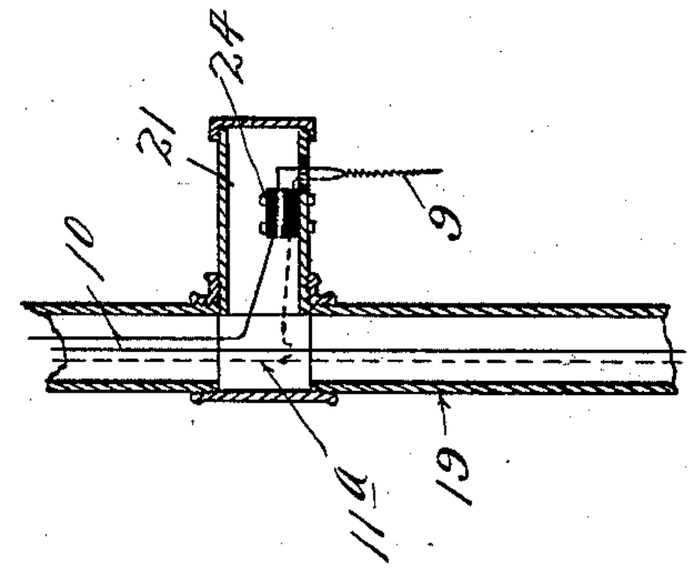

Fig. 7.

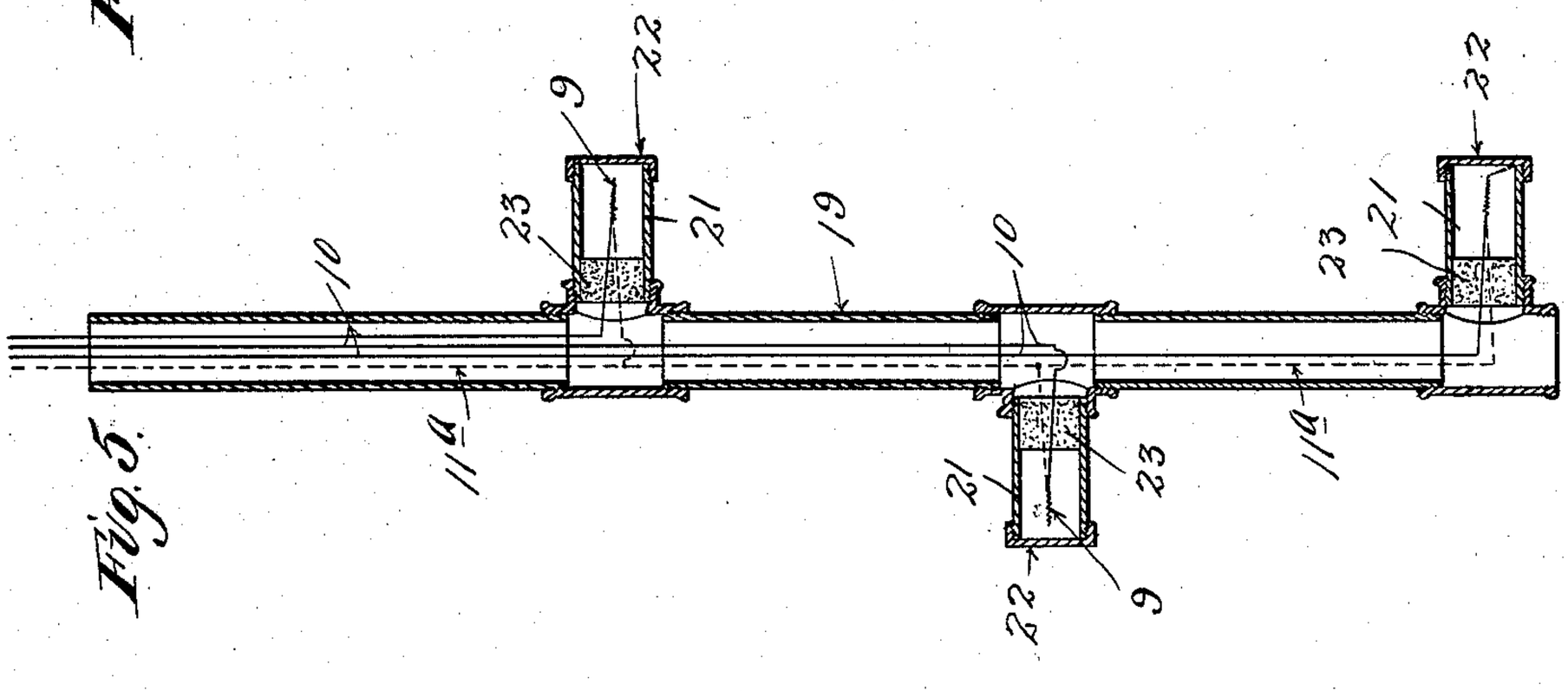

Fig. 5.

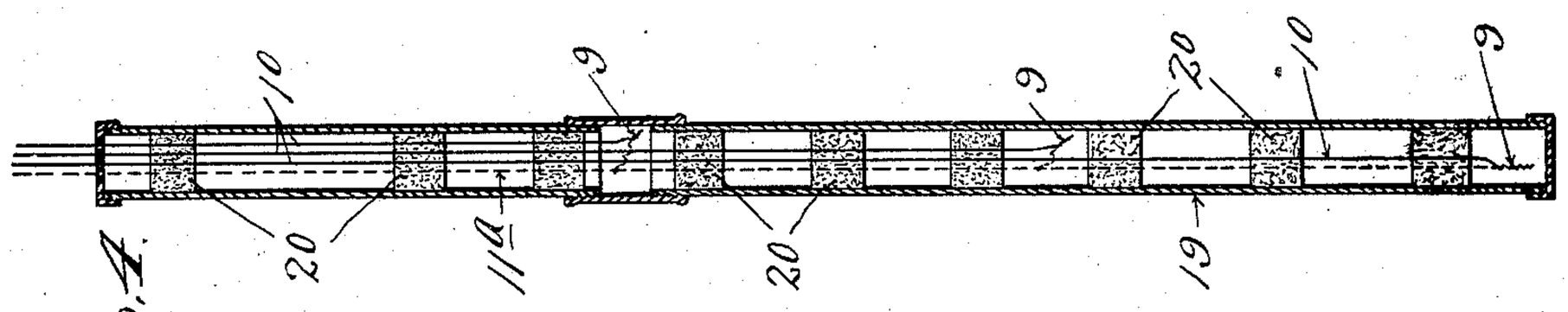

Fig. 4.

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UNITED STATES PATENT OFFICE.

ANTHONY ZELENY, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR OF ONE-HALF TO C. E. THAYER, OF MINNEAPOLIS, MINNESOTA.

MULTIPLEX ELECTRIC THERMOMETER.

SPECIFICATION forming part of Letters Patent No. 705,187, dated July 22, 1902.

Application filed January 20, 1902. Serial No. 90,402. (No model.)

To all whom it may concern:

Be it known that I, ANTHONY ZELENY, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Multiplex Electric Thermometers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention has for its object to provide improved means for readily determining at a reading-station the temperature at various distant points; and to this end it consists of the novel devices and combinations of devices hereinafter described, and defined in the claims.

My improved device for accomplishing the above result may very properly be designated as a "multiplex electric thermometer." It involves the use of a plurality of thermo-electric circuits or couples having individual thermo-electric junctions and a common thermo-electric junction. The common thermo-electric junction is preferably located at or in the immediate vicinity of the reading-station, and as its temperature is either known or capable of being readily determined it may be designated as the "known-temperature" junction. The individual junctions are located at various distant points, and as their temperatures are to be determined by the use of the instrument they may be properly designated as the "unknown-temperature" junctions.

A galvanometer or reading instrument is connected in one of the leads to the common or known-temperature junction, and a switch is also provided whereby any thermo-electric circuit or couple may be closed into circuit with the common thermo-electric junction and common galvanometer. Otherwise stated, by means of the switch the common or known-temperature junction may be balanced against or made to react against any one of the individual or unknown-temperature junctions, and the galvanometer will indicate the temperature at such unknown-temperature or distant junction. The system involves other novel and important features of construction, all of which will hereinafter appear.

This improved multiplex electric thermometer is capable of a very wide range of different uses; but in the drawings it is illustrated as applied for determining temperature at different levels in a series of storage-bins, such as are used in grain-elevators.

In the drawings like characters indicate like parts throughout the several views.

Figure 1 is a view principally in diagram, but with some parts shown in vertical section, illustrating my improved device applied as above indicated. Fig. 2 is a detail view in plan, showing the switch and switchboard on an enlarged scale. Fig. 3 is a vertical section on the line 3 3 of Fig. 2. Fig. 4 is a vertical section showing in detail a portion of one of the incasing tubes for the so-called "individual" or "unknown-temperature" junctions. Fig. 5 is a view corresponding to Fig. 4, but illustrating a slightly-modified construction of the said tube. Figs. 6 and 7 are also detail views in vertical section, illustrating modified constructions of the incasing tubes and of the thermo-electric junctions supported thereby.

The numeral 1 indicates grain-storage bins.

The numeral 2 indicates a switchboard having contact-pins 3. A switch-lever 4, pivoted to said switchboard 2, is provided at its free end with a sliding contact-head 5, which coöperates with the contact-pins 3 and, as shown, is adapted to be frictionally held in its set position by a spring-pressed pin 6. (Best shown in Fig. 3.)

The numeral 7 indicates a suitable galvanometer or other reading instrument which is sensitive to current-flow.

The numeral 8 indicates the common thermo-electric junction, and the numeral 9 indicates the individual thermo-electric junctions, the former of which is located at the reading-station or in the vicinity of the galvanometer and switch and the latter of which are distributed at different points within the bins 1. In the illustration given these thermo-electric junctions 8 and 9 are formed of copper and German-silver wires twisted and soldered together. The common or known-temperature thermo-electric junction 8 is arranged to react against or act in opposition to any of the individual or unknown-temperature junctions 9 with which it is coupled.

This will be apparent by noting that the copper wires 10 and 10ª are indicated by full lines, while the German-silver wires 11, 11ª, and 11ᵇ are indicated by dotted lines. The said wires 10 extend one from each junction 9 to a different pin 3 of the switchboard 2. The sliding contact-head 5 is connected to the copper member of the common junction 8 by the wire 10ª, and the galvanometer 7 is shown as interposed between the sections of said wire 10ª. The German-silver member of said common junction 8 is connected to the German-silver member of all of the individual or unknown-temperature junctions 9 by the common German-silver return-wire 11, having branches 11ª.

The numeral 12 indicates a resistance-coil afforded by what is known as a "low-temperature-coefficient" coil or wire—that is, a coil or body of wire whose resistance remains approximately constant under varying temperatures. The coil 12 is shown as interposed between sections of the return-wire 11, in the vicinity of the common junction 8, and its connections therewith are indicated at 12ª. These connections 12ª to some extent constitute thermo-electric junctions, and to prevent the same from interfering with the proper actions between the junctions 8 and 9 it is essential that they be kept at the same temperature, and hence equally balanced. For this reason the said coil 12 is preferably placed within a tight box or inclosing compartment 13. The thermo-electric junction 8 is also shown as placed within a box or closed compartment 14, into which also the lower or bulb end of an ordinary thermometer 15 is placed.

The numeral 16 indicates a thermo-electric junction of the same character as those described, but which is located at a distant point from the reading-station and is adapted to be used for testing purposes—that is, for testing the accuracy of the system. The German-silver member of this junction 16 is shown as connected to the return-wire 11 by a German-silver wire 11ᵇ. The copper member of said junction 16 is connected to a pin on the switchboard 2 by a copper wire 10ᵇ. The said junction 16 is also preferably inclosed in a tight box 17, into which also the bulb or lower end of an ordinary thermometer 18 is placed. This testing-junction 16 and its connections are not an essential feature of my invention.

To protect the wires and the junctions 9 from the grain or other material with which the bins will be filled, they are preferably placed within metal pipes or tubes, as shown at 19 in Fig. 4. These tubes or pipes 19 will be properly supported within the bins, preferably from the overhead bin-supports. (Not shown.) To confine the air surrounding the junctions 9 and prevent the circulation thereof upward through the pipe 19, plugs 20 are shown as placed within the said pipes.

In the construction illustrated in Fig. 5 the pipe 19 is provided with laterally-projecting thimbles 21, in which the junctions 9 are inclosed. The outer ends of the said thimbles 21 are shown as closed by caps 22, while their inner ends are shown as closed by plugs 23. The construction illustrated in Fig. 6 is substantially the same as that illustrated in Fig. 4, the only difference being that the wires 10 and 11ª are directly connected to form the junctions 9.

The construction illustrated in Fig. 7 involves the pipe 19 with projecting thimbles 21; but in this construction the thermo-electric junctions 9 project through and depend from said thimbles 21, so that they may come in direct contact with the grain or other materials stored in the bins. These depending junctions 9 and their leads are of course insulated from the pipe 19 and thimbles 21. As shown, insulating-clamps 24, applied to said thimbles 21, hold the leads of the said junctions. Instead of the metal pipes 19 hollow flexible cables, of wire or other suitable material, may be used. It will also be understood that the wires or leads 10 and 11 where they extend between the incasing tubes 19 and the switchboard 2 may be protected in any suitable way—as, for instance, by being formed into a covered cable. It will be noted that by the use of the switchboard and switch illustrated a very large number of distant individual or unknown-temperature junctions may be coupled into circuit with the common junction 8. In the drawings only six of these individual junctions 9 are shown, and hence but six of the switchboard-pins 3 are used in connection therewith.

The operation of the device described will be substantially as follows: For one illustration we will assume that the common junction 8 is kept at the constant temperature of melting ice—to wit, 32° Fahrenheit. Now it is evident that if the temperature of the particular individual junction 9 which is coupled into circuit with the said common junction 8 is also at the temperature of melting ice there will be no current-flow through the closed thermo-electric circuit or couple, for the reason that the two thermo-electric junctions 8 and 9 are balanced against each other. If, however, the temperature of the two junctions thus closed into circuit are different, there will be a flow in the one direction or the other through the closed thermo-electric circuit or couple, and this flow will be indicated by the galvanometer. So far as my present invention is concerned the galvanometer may be made to read either in degrees directly or in volts or amperes, which are capable of being translated into degrees. However, it is my intention to use in connection with this system a galvanometer of the general character set forth and claimed in a companion application filed by me of even date herewith, entitled "Galvanometer." By the use of my improved galvanometer the

temperature of a distant individual junction 9 may be directly read even where the temperature of the common or known junction 8 is permitted to vary. The resistance or low-temperature-coefficient coil 12 makes negligible errors in readings due to different lengths of various circuits and to change of resistance in the wires of the system due to varying temperatures. Furthermore, the said coil serves to reduce to convenient length the divisions on the scale.

It will of course be understood that any suitable combination of metal wires or leads may be used to form the thermo-electric junctions. For instance, iron and copper might be used in some cases.

As already indicated, the device is capable of a very wide range of use. It is of course especially serviceable for indicating the temperatures at various inaccessible points, such as within bodies or piles of grain contained in bins or coal contained in the bunkers of vessels or in storage.

The device is also very serviceable for indicating the temperature at various distant points, which while accessible can be much more conveniently read from a common point or station, such as the temperatures in the various parts of cold-storage plants.

The device is of course capable of a large range of modification as to details of construction and arrangement of parts within the scope of my invention as herein claimed. It will of course be understood that various other combinations of metals may be used for the thermo-electric junctions and wires of the couples or thermo-electric circuits.

The expression "galvanometer" is herein used in a very broad sense to include any measuring instrument which is sensitive to an electric current or to a difference of potential.

The expression "switch" is herein used in a broad sense to cover all devices capable of use to open and close the various circuits.

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

1. The combination with a galvanometer and a switch, of a plurality of thermo-electric circuits having individual thermo-electric junctions and a common thermo-electric junction, which common junction, by said switch, may be connected with any opposing individual junction, to complete the thermo-electric circuit, substantially as described.

2. The combination with a plurality of thermo-electric couples having a common lead of a different metal than that of the individual leads, of a common galvanometer and a switch for closing any couple into circuit with said galvanometer, substantially as described.

3. The combination with a switch and a galvanometer, of a plurality of thermo-electric circuits having individual thermo-electric junctions and a common thermo-electric junction, which common junction is in one of the leads to said galvanometer and, by said switch, is adapted to be connected with any opposing individual junction, to complete the thermo-electric circuit, substantially as described.

4. The combination with a galvanometer and a switch, of a plurality of thermo-electric circuits having a common return-lead and provided with individual thermo-electric junctions and a common thermo-electric junction, which common junction, by said switch, may be connected with any opposing individual junction, to complete the thermo-electric circuit, substantially as described.

5. The combination with a galvanometer and a switch, of a plurality of thermo-electric circuits having individual thermo-electric junctions, a common thermo-electric junction, and a resistance coil or device in one of the leads to said common junction, which common junction, by said switch, may be connected with any opposing individual junction, to complete the thermo-electric circuit, substantially as described.

6. The combination with a galvanometer and a switch, of a plurality of thermo-electric circuits of different length and resistance, having individual thermo-electric junctions, a common thermo-electric junction and a common low-temperature-coefficient resistance-wire, which common junction, by said switch, may be connected with any opposing individual junction, to complete the thermo-electric circuit, substantially as described.

7. The combination with a plurality of thermo-electric circuits and a switch, of a common branch of high resistance including a galvanometer, which common branch, by said switch, is capable of being connected into any one of the thermo-electric circuits, whereby said circuits, when successively closed, have practically equal resistance enabling equal differences in temperature to produce, in the said various circuits, equal deflections on the common galvanometer, substantially as described.

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

ANTHONY ZELENY.

Witnesses:

ELIZABETH KELIHER,

F. D. MERCHANT.