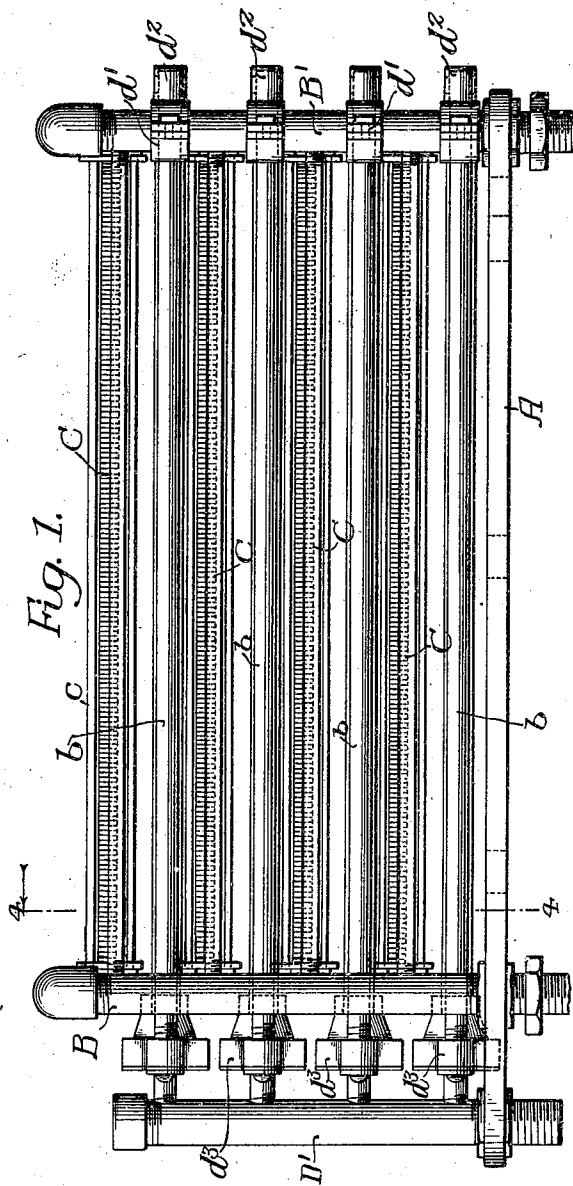
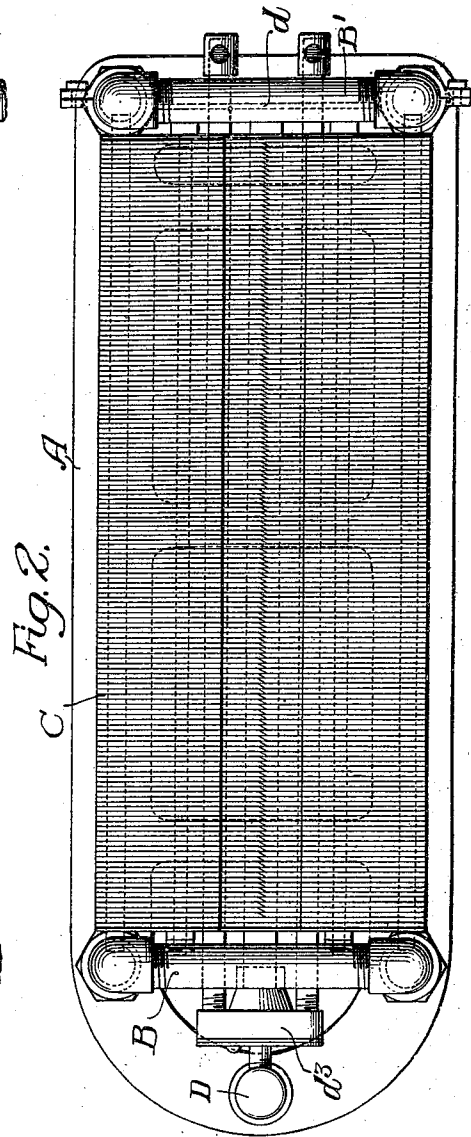


G. J. VOKEL.
PYRO-ELECTRIC GENERATOR.
APPLICATION FILED JAN. 21, 1909.

928,089.

Patented July 13, 1909.
2 SHEETS—SHEET 1.



Witnesses:
Edw. H. Irons.
Wm. A. Burrows

Inventor:
George J. Vokel.
by his Attorneys:
Hoyson & Hoyson

928,089.

Patented July 13, 1909.

2 SHEETS—SHEET 2.

Fig. 3.

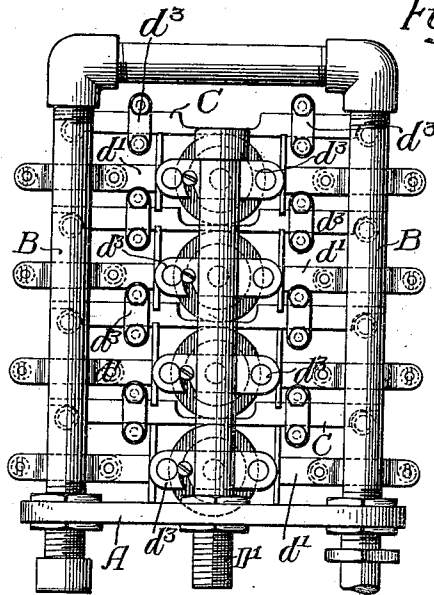


Fig. 5.

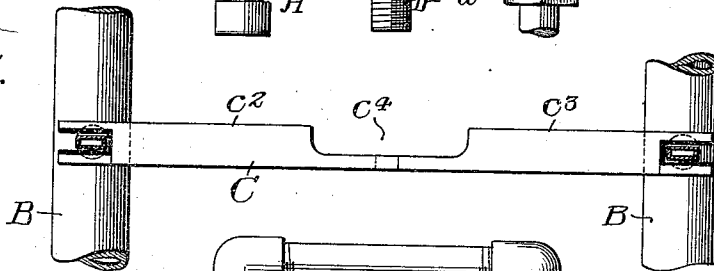


Fig. 6.

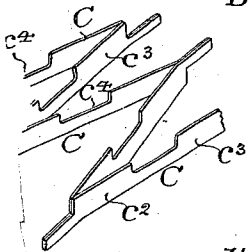
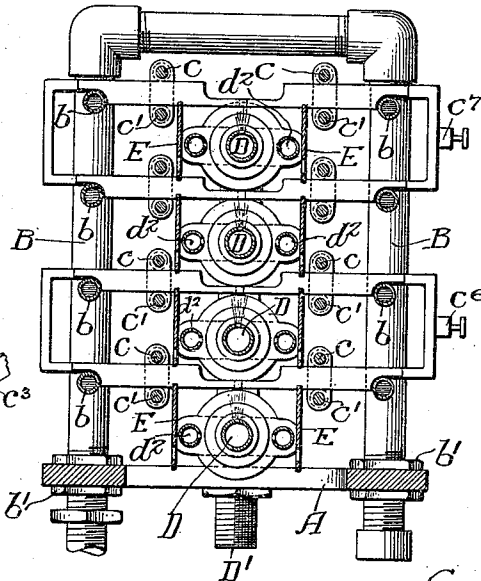


Fig. 4.



Witness
H. Dross
A. Burrows

Inventor
George J. Vokel.
by his Attorneys
Houson & Houson

UNITED STATES PATENT OFFICE.

GEORGE J. VOKEL, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO C. THOMAS WALTZ, OF PHILADELPHIA, PENNSYLVANIA.

PYRO-ELECTRIC GENERATOR.

No. 928,089.

Specification of Letters Patent.

Patented July 13, 1909.

Application filed January 21, 1909. Serial No. 473,443.

To all whom it may concern:

Be it known that I, GEORGE J. VOKEL, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Pyro-Electric Generators, of which the following is a specification.

One object of my invention is to provide an apparatus capable of producing electrical energy directly from heat, which shall be of such a construction as to be relatively efficient, durable, and compact as to the disposition of its various parts.

It is further desired to provide an electric generator of the type above noted, with a novel construction and arrangement of cooling and heating means, as well as with couples of novel composition, arrangement and construction, whereby the compact arrangement of the various parts is facilitated and the efficiency of the apparatus is increased.

These objects and other advantageous ends I secure as hereinafter set forth, reference being had to the accompanying drawings, in which:—

Figure 1, is a side elevation of my improved generator; Fig. 2, is a plan view; Fig. 3, is an end elevation; Fig. 4, is a vertical section on the line 4—4, Fig. 1; Fig. 5, is an enlarged side elevation of certain of the couples and their associated cooling apparatus; and Fig. 6, is a perspective view showing a group of couples in an open position in order to illustrate their form and method of connection.

In the above drawings, the frame of the apparatus consists of a relatively heavy plate A of elongated form and preferably cut away at its central portions for the sake of lightness. In the present instance it has mounted at its ends two water supply pipes B and B', each of which may be described as of the form of an inverted U. Assuming that the plate A is normally supported in a horizontal plane, the adjacent vertical sides of the water supply pipes B and B' are respectively connected to each other by horizontally extending pipes or tubes b, which may be either circular in section as in Fig. 1, or rectangular, as indicated in Fig. 5.

From Figs. 3 and 4, it will be seen that the water pipes B and B' are rigidly held to the supporting plate or frame A by means

of jam nuts b' and that one end of each of said pipes is blanked, while the remaining ends are respectively connected to a source of supply of water and a receptacle for waste water.

The horizontally extending water pipes b are arranged in a series of pairs at substantially the same level and they serve to a greater or less extent as the supporting means for the various series of thermocouples C, each of which—as shown in Fig. 4,—is of such dimensions that its two extremities rest upon the two pipes b of one pair. The two members c² and c³ of each couple are of the same length and are joined to each other in what is the longitudinal median plane of the generator, being cut away as shown at c⁴ so as to be of relatively small cross section for some distance adjacent to their point of junction in order that such portion may be more easily raised to and maintained at a relatively elevated temperature. As will be seen from Figs. 1 and 2, the various couples of each series constitute a layer or floor carried by a pair of transverse tubes b and the couples of each layer are clamped together so as to form a unitary body by any desired number of pairs of bolts c and c'; one bolt of each pair extending above and the other below the layer of couples and being united at their ends by suitable clamping plates.

Under each layer or series of couples I mount a burner D which extends from one end to the other of the generator, there being in the present instance four such burners. At one end these burners are carried by and supplied with fuel from a vertically extending pipe D', which is rigidly mounted on and carried by the plate A, while their opposite ends are supported by transversely extending bars d, shown in dotted lines in Fig. 2, whose ends are held by means of clamps d' to the side or vertical members of the end water pipe B'. In order to aid in the combustion of the fuel I heat the air delivered to the burners and for this purpose I extend immediately adjacent to each burner and on each side thereof an air pipe d². From Figs. 1 and 2, it will be seen that the ends of each pair of these air pipes are open and project at one end of the apparatus, while their opposite ends are connected to a mixing chamber d³ to which fuel is delivered from

the supply pipe D':—there being also, if desired, openings in the sides of the said air pipes.

It will be understood that suitable insulating material is placed between the various couples themselves and also between the ends of the couples and the water pipes *b* upon which they are carried. Plates E of slate, lava, or other refractory material are mounted between the various layers of couples and between the bottom layer of couples and the plate A so as to form heating chambers, each of which incloses a burner D with its air pipes so as to limit as far as possible the heating effects of the burning fuel to the portions of each couple immediately adjacent to the junction of the two members constituting the same.

It is, of course, obvious that the various couples may be electrically connected in any desired way to secure any given voltage and current and they are provided with terminals *c*⁶ and *c*⁷ to which connection may be made between the generator and the apparatus to be supplied with current.

Under operating conditions, water or other cooling fluid is circulated through the pipes B, B' and *b*, and fuel, supplied through the pipe D', is burned in each of the chambers formed by the slate side plates E and the central portions of the layers of couples; the air for combustion being preheated by being drawn into the end openings of the pipes or it may be taken in a heated condition from within the chambers through the openings in the sides of said air pipes *d*². The central points of junction of the couples are thus intensely heated, while their extremities are cooled by reason of their engagement with or proximity to the pipes *b*. As a consequence, the heat energy developed is transformed into electrical energy, which is delivered at the terminals *c*⁶ and *c*⁷.

From the drawings and the above description it will be understood that the apparatus as a whole is of a most compact and substantial nature, for its various parts are well held together and are substantially formed, so that the liability to injury and the requirement for repairs are reduced to a minimum; in addition, owing to the compact construction and arrangement, the efficiency of the apparatus is relatively high.

Owing to the small cross section of the couples immediately over the burners, it is possible to maintain them at a relatively high temperature without combustion of as much fuel as has hitherto been required, while the various couples may be connected to each other as illustrated in Fig. 4, or as in Fig. 6. In the former case their outer extremities rest upon the top side of the pipes *b*, whereas in the latter case, the extremities of the various couples alternate with each other in bearing upon the top and

bottom sides of the pipes *b*. These same pipes may be either circular in section, as shown in Fig. 4, or rectangular, as in Fig. 5, as may be most convenient.

One of the elements of each couple consists of a body of pure chromium, which may be either solid, or if desired, plated upon a supporting structure of iron or any other suitable metal, while the other element preferably consists of an alloy formed of substantially 65% copper and 35% nickel.

I claim:—

1. A pyro-electric generator consisting of a tubular framework for the reception of cooling fluid, a series of thermocouples having their end portions resting upon a part of said framework so as to be cooled thereby, and means for heating the said couples.

2. A pyro-electric generator consisting of a supporting frame, a plurality of series of thermocouples mounted on said frame and each having a portion of less cross section than the remainder, and means for heating said reduced portion of each series of couples.

3. The combination of a tubular framework for the reception of cooling fluid, a plurality of series of thermocouples arranged in layers and having certain portions extending adjacent to the framework so as to be cooled thereby, with a heating device for each layer of couples.

4. The combination of a frame, a plurality of series of thermocouples supported thereon, bodies of refractory material extending between the adjacent series of couples to form an inclosure, and a heating device for the couples mounted within said inclosure.

5. The combination of a frame, a plurality of series of thermocouples mounted in a plurality of layers and arranged so that their ends shall be cooled by said frame, plates of refractory material extending between adjacent series of couples to form an inclosure, and a burner mounted within each inclosure so as to heat the points of junction of the couples.

6. A pyro-electric generator consisting of a framework, a series of thermocouples, means forming with said series of couples an inclosed space, a burner extending in said inclosed space and connected to a source of fuel supply, with air supply tubes connected to said burner and also extending through said inclosed space.

7. A pyro-electric generator consisting of a tubular framework including end members and tubes connecting the same, a number of series of thermocouples resting at their ends upon said tubes, with means for heating each series of couples at points between the tubes.

8. A pyro-electric generator consisting of a tubular framework including end members and tubes connecting the same, a number of series of thermocouples resting at

their ends upon said tubes, with means for heating each series of couples at points between the tubes, and plates of refractory material extending between adjacent couples so as to inclose said heating means.

- 5 9. A pyro-electric generator consisting of a tubular framework having a number of pairs of hollow supporting tubes for the reception of cooling fluid, a series of thermo-couples resting upon each pair of such tubes, means for clamping together the couples of each series, and independent heating devices supplied from a common source of fuel for heating the respective series of couples.
- 10 10. A pyro-electric generator consisting of

a tubular framework, a series of thermocouples, of which each couple has its end portions cut away and resting upon portions of said tubular structure, the point of junction of the elements of each couple being of a cross section less than that of the body of the couple, with heating means for said couples.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

GEORGE J. VOKEL.

Witnesses:

WILLIAM E. BRADLEY,
WM. A. BARR.