Fig. 1.
The invention relates to a method of producing light by means of a flame of very short duration and predetermined spectrum.

An object of the invention is the production of light, particularly of certain colors, e.g., spectral colors, by igniting or incandescing, discrete particles by electric sparks which are rhythmically produced as a sequence.

The apparatus for executing the method of the invention comprises a sparkers, or spark plug enclosed in a sparking chamber of nozzle form having an aperture to the outside. The sparkers is operated from an electrical circuit with condenser and a switch member, such as a vibrator, interrupter which rhythmically and alternatingly connects the condenser to the electrical circuit and to the sparkers thus exciting a sequence of sparks. The nozzle-shaped chamber is connected by means of a rather narrow conduit with a source of liquid containing particles which may be ignited or incandesced, by the energy of the sparks and when so ignited or incandesced emit light of their characteristic color or spectral composition.

In accordance with the method of the invention, a flow of the liquid is supplied to the sparking chamber. When the sequence of sparks is initiated, the liquid in the sparking chamber, by the energy of the spark, is suddenly evaporated and thus exploded, ejected from the chamber through its aperture and atomized. During the sequence of sparks a flow of the liquid to the chamber is maintained but at low velocity so that the chamber is refilled only partly, and the sparks through the unfilled part of the chamber and through the aperture, may reach the ejected and atomized liquid and may ignite the ignitable particles or through their heat may incandesce incombustible particles and also ignite the atomized liquid, if combustible.

The invention thus substantially consists therein, that an inflammable or ignitable substance is ejected from a chamber through an aperture thereof by the energy of an electric spark produced in said chamber by the discharge of a condenser and that the capacity of the spark chamber, the degree of filling thereof and the energy of the spark are so chosen that the ejected substance is also ignited by said spark. It has been found that when the substance to be ejected is appropriately chosen, a flame of great intensity or of special colour can be obtained, which can be successfully used for various purposes such as photography, projection, stroboscopic measuring. As inflammable substance a liquid solution or a liquid or pulpy mixture of substances may be used, of which solution or mixture at least one of the components, after being atomized, is inflammable and produces a flame of great intensity and predetermined spectrum. A liquid or pulpy substance can easily be supplied to the spark chamber and ejected therefrom.

As a liquid containing particles capable of being ignited by the sparks, a mixture of a combustible liquid, e.g., mineral oil, and an ignitable powder, e.g., magnesium powder, iron powder, copper powder, carbon powder, etc., may be used. The mixture produces a flame of great intensity of light and of a certain colour. Magnesium and iron powder produce a bright white flame, copper powder gives a green flame, carbon powder a yellow flame. It will be apparent that other metal or electrically conductive powders may also be used.

As an ignitable substance, a mixture of a combustible liquid and an incombustible powder, for instance common salt, may be used. In that case the salt only serves for colouring the flame, which will be yellow.

The liquid need not be combustible. A mixture of water and for instance magnesium powder produces after its ejection and subsequent ignition a blinding white light. In this case the water is only used to obtain a more or less fluid substance which can be supplied and atomized.

Since the discharging spark of a condenser can easily be generated with a determined frequency the method in accordance with the invention is very appropriate for photographing moving or varying objects, projecting cinematographic films or stroboscopic measurements.

When for instance photography is concerned the colour of the flame can be well adjusted to the sensitibility of the photographic material in a simple manner.

In order that the invention may be better understood reference is made to the accompanying drawing of which Figure 1 illustrates diagrammatically and partly in section an apparatus for carrying out the method according to the invention, and Figure 2 illustrates one example of a complete installation embodying the apparatus of Figure 1.

In the drawing 1 designates a metal holder in which a chamber 2 is formed. The back wall of said chamber is constituted by the active surface 3 of a low tension spark-plug 4, which is screwed in said holder. The chamber 2 opens to the outside through a small aperture 5. Through a narrow passage 6 a liquid or pulpy substance, for instance a mixture of various components, of which
at least one is a liquid and at least one is ignitible, is supplied to said chamber. The plug is provided with a packing ring 7 and it is connected to a condenser 9 through a throw-over switch 8. Said switch is periodically switched over and it automatically connects the condenser 9 to a source of electric energy, indicated in the drawing in the conventional way, for loading said condenser and to said spark plug for discharging it.

The discharging spark creeps or slides over the active surface 3 of the spark plug and ejects by its energy the substance contained within chamber 2 with great force through aperture 5 so that it is atomized and ignited by the sparking of the same spark.

In Figure 2 the passage 60 opens with its end remote from 2 in a chamber 10 of predetermined volume. This end of passage 6 is formed as a seat for a ball check valve 11. Opposite to passage 6 the chamber 10 is connected to a passage 12 for the supply of the inflammable substance from a reservoir 13, which is supplied through a pipe line 14 either by gravity or under pressure. The end of passage 12 opening in chamber 10 is also formed as a seat for the check ball 11. When a spark is produced in the chamber 2 the inflammable substance in the passage 6 is thrown back and the ball 11 is lifted and thrown against the seat of passage 12 thereby closing the supply pipe 14. After the fluid has been driven out of chamber 2 through aperture 5 and the pressure in said chamber 2 has been reduced the ball 11 is driven back to its original position by the pressure of the substance supplied through pipe 14. Owing to this movement of ball 11 a quantity of substance defined by the volume of chamber 10 is pressed into chamber 2. In operation ball 11 jumps up and down with a frequency which depends on the frequency of the sparks produced on plus 3, 4. The house 15 enclosing chamber 10 is screwed to holder 4. By screwing said house from said holder the volume of chamber 16 is enlarged and by screwing it to the holder said volume is reduced. In that way the quantity of substance which is supplied each time after a flash is easily regulated. When the pressure of the sparks raised above a certain value, the pressure exerted on the supplied substance must also be increased.

For loading and discharging condenser 9 and actuating the throw-over switch 8 a device according to the U. S. Patent 2,416,027 to Smits may be used. In the drawing 16 is the low tension winding and 17 is the high tension winding of an induction coil. The low tension winding 16 is fed by battery 18 through an electro-magnet 19 and a mechanically driven interrupter 20. The movable switch part 3 is attracted by the magnet 19 against the force of spring 21. Each time the interrupter 20 closes its contacts the electro-magnet attracts the switch 8 and thus connects the condenser 9 to the induction coil, which produces at the same time a loading impulse by the high tension winding 17. As soon as the interrupter 20 breaks its contacts the electro-magnet becomes dead and spring 21 pulls the switch 8 away, whereby the condenser 9 is connected to the spark plug and is discharged directly through said plug. The frequency of switch 8 depends on the number of revolutions per unit of time of the cam shaft of the interrupter. If high frequencies should be required, the interrupter and the switch 8 may be replaced by electronic means in a manner well known in the art. It is also possible to move switch 8 by pure mechanical means and to load condenser 9 by means of direct current from an alternating current source such as a transformer through a rectifier. The invention does not reside in the manner of how the fuel is supplied or how the sparks are produced but in producing flashes of light by means of condenser discharges in a small chamber having a narrow outlet aperture and entirely or partly filled with an inflammable atomizable substance. Applicant obtained excellent results with a device consisting of parts having the following values. Voltage of the electrical source about 1500 volts, capacity of the condenser 15 microfarads, volume of the ignition chamber 0.5 mm3. These data may be varied in all directions. Stronger flashes be required the capacity of the condenser on the loading voltage thereof have to be increased.

What I claim is:

1. The method of producing light by means of a rhythmically operated electrical sparkler enclosed in a nozzle-like space with an opening to the outside, said method including the steps of supplying to said space a flow of liquid containing particles capable of being ignited by electric sparks, producing a sequence of sparks within said space and, by the energy of said sparks, evaporating, exploding said liquid and ejecting it from said space while atomizing it, maintaining during said sequence of sparks said flow of liquid into said space at low velocity so as to refill said space only partly during said sequence of sparks and thereby allow the sparks of said sequence to reach through the unfilled portion of said space and through said opening said ejected and atomized liquid and ignite said particles.

2. The method as set forth in claim 1 wherein said liquid containing particles a mixture of a combustible liquid and a powder ignitable by said sparks is employed.

3. The method as set forth in claim 1 wherein said liquid mineral oil is employed with which an electrically conductive powder ignitable by said sparks is admixed.

4. The method as set forth in claim 1 wherein said liquid mineral oil is employed with which an electrically conductive powder ignitable by said sparks is admixed.

5. The method as set forth in claim 1 wherein said liquid mineral oil is employed with which a metallic powder ignitable by said sparks is admixed.

6. The method as set forth in claim 1 wherein said liquid mineral oil is employed with which a metallic powder ignitable by said sparks is admixed.

7. The method as set forth in claim 1 wherein said liquid mineral oil is employed with which a sodium chloride powder is admixed.

8. The method as set forth in claim 1 wherein said liquid water is employed with which an electrically conductive powder ignitable by said sparks is admixed.

9. An apparatus for producing light of certain spectral colors comprising a sparkler, a nozzle-like sparking chamber enclosing said sparkler, and having an aperture opening to the outside, said sparkler being operated by an electric circuit with condenser and switch member, said sparking chamber adapted to connect rhythmically and alternatingly said condenser to said circuit and to said sparkler; in combination with a source of liquid containing particles capable of being ignited by the energy of said sparks, and a narrow conduit opening into said sparking chamber outside of the sparking zone, and connecting said chamber to said source of liquid, thereby, by means of said sparkers, to produce a sequence of spark dis-
charges evaporating, exploding the liquid contained in said chamber, ejecting it to the outside through said aperture and atomizing it, and by said narrow conduit maintain, during said sequence of sparks, a flow of said liquid to said chamber and refilling the same only partly during said sequence and thus to allow the sparks of said sequence to reach, through the unfilled portion of said chamber and through said aperture, said ejected and atomized liquid and ignite said particles.

WYTZE BEYE SMITS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,401,706</td>
<td>Kahn</td>
<td>Dec. 27, 1921</td>
</tr>
<tr>
<td>2,125,035</td>
<td>Smits</td>
<td>July 26, 1938</td>
</tr>
<tr>
<td>2,384,438</td>
<td>Bucy</td>
<td>Sept. 11, 1945</td>
</tr>
</tbody>
</table>

FOREIGN PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Country</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>699,720</td>
<td>Germany</td>
<td>Dec. 28, 1940</td>
</tr>
</tbody>
</table>