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FIRST FIRE AND IGNITER COMPOSITION
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The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to me of any royalty thereon.

The present invention relates to a new type of first fire and igniter composition primarily adapted for use in powder trains of ammunition to provide a definite burning time interval. More particularly, this invention relates to a first fire and igniter composition of the type used in firing devices such as squibs and igniters which are generally used with military pyrotechnics such as flares, signals, ramjet and rocket igniters, smokes, guided missiles and similar munitions and which will ignite readily and function at altitudes up to 250,000 feet or higher and at speeds exceeding that of sound.

Compositions heretofore used in first fire and igniter mixtures, as well as electric squibs for the ignition of pyrotechnic devices and other munitions, have a serious disadvantage in that they are difficult to ignite, or will not ignite at reduced pressures below atmospheric pressure and will not cause the ignition of the next element in the powder train of the munition in which they are designed to function. Since many pyrotechnic devices and other munitions such as flares, signals, photoflash bombs and cartridges, rockets and guided missiles are now employed at very high altitudes and, in some instances, from planes having speeds in excess of the speed of sound, it is essential that the first fire compositions, igniters and squibs used to initiate such munitions or elements thereof, ignite readily and function at very high altitudes such as, for example, 250,000 feet or higher and at speeds exceeding that of sound.

It is, therefore, a primary object of this invention to provide a composition which when used in a squib, igniter, and first fire mixture, will be very easy to ignite at reduced air pressures and under conditions of limited oxygen supply such as exist at very high altitudes, such as 250,000 feet or even higher.

It is a further object of this invention to produce a first fire and igniter composition which may easily be ignited electrically by means of a heated resistance wire or which will ignite from a primer or flash at reduced pressures.

It is a still further object of this invention to provide a mixture for use as a first fire and igniter composition which will operate satisfactorily at very high altitudes and at speeds exceeding that of the speed of sound.

Pursuant to the objects listed above, I have discovered that compositions containing powdered zirconium, sulfur and potassium perchlorate, in a very finely divided state, together with a binder, when used as an igniter or first fire composition, or both, or when used in a squib containing a bridge wire, will be readily ignited and, in turn, will readily ignite the next element or composition in a powder or explosive train at sub-atmospheric pressures under such conditions as exist at altitudes of 250,000 feet or higher.

None of the related compositions taught by the prior art are considered suitable for use as a first fire composition to ignite pyrotechnic compositions or similar items at high altitudes where there is very little oxygen available in the atmosphere. The composition of this invention, however, containing as it does potassium perchlorate,

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provides sufficient available oxygen to make the composition function at high altitudes under conditions of limited oxygen supply. Furthermore, the proposed composition has proved to be stable in the presence of moisture and to possess a desirably high heat of reaction.

The following composition represents a preferred embodiment of the first fire and igniter composition of this invention:

	Percent
Zirconium, powdered	75±2
Sulfur	20±2
Potassium perchlorate	5±1

An additional 5±1% of cellulose nitrate lacquer may be blended with the above mixture to serve as a binder. All percentages given above and elsewhere in this disclosure are percentages by weight unless specifically designated otherwise.

Other binders may be used in the same proportion in place of the cellulose nitrate lacquer of the preferred embodiment given above. Examples of such binders are polyesters, for example, Laminac (a synthetic resin consisting of 100 percent reactive copolymers); polystyrene, Thiokol (a polysulfide synthetic rubber having the formula $C_2H_2S_4$ made by the interaction of ethylene dichloride and sodium polysulfide); epoxy resins and similar liquid polymers.

The proportions of the ingredients of the first fire and igniter composition of this invention may be varied over a wide range to achieve any desired burning time. In order to obtain longer burning times, less zirconium and greater amounts of sulfur and binder may be used up to a maximum of 60 percent zirconium, and 10 percent binder. For shorter burning times the percentage of potassium perchlorate can be increased up to 20 percent at the expense of the sulfur. Specifically, the ingredients of this igniter composition may vary as follows:

	Percent
Zirconium powder	60-70
Sulfur	5-30
Potassium perchlorate	5-20
Binder	5-10

These new igniter, first fire and squib compositions are very readily prepared. However, careful control of the particle size of the ingredients is essential for proper results. It is desirable that all of the ingredients be finely divided so as to pass through a 250 mesh screen. The zirconium powder, however, should all pass through a 325 mesh screen.

In order to produce a fixed, more uniform burning time over extreme temperature ranges, the zirconium powder may be dichromated. The powdered zirconium may be dichromated by immersion in an aqueous solution of from 1 to 20% sodium dichromate containing less than one percent of an alkali acid sulfate and boiling for one-half hour. After filtering, the dichromated powder is dried at 100° C.

Incorporation of the powdered ingredients is accomplished by blending with nitrocellulose lacquer which has been diluted with sufficient solvent for effective mixing. For this purpose any of the common solvents for nitrocellulose may be employed.

In the foregoing description I have described the preferred embodiment of my invention. However, it is not intended that this invention be limited to the specific examples set forth above as it will be apparent to those skilled in the art that by varying the proportions of the combining ingredients; viz, metals and solid non-metallic elements, the burning rates of the ignition composition may be varied over a wide range without departing from the spirit of the invention or exceeding the scope of the appended claims.

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Having thus described the invention, what is claimed as new is:

1. A first fire and igniter composition consisting essentially of, by weight, 60 to 75 percent of zirconium, 5 to 30 percent of sulfur, 5 to 20 percent of potassium perchlorate, all of said ingredients being finely divided so as to pass through a 250 mesh screen.

2. The composition according to claim 1 wherein the zirconium is sufficiently finely divided so as to pass through a 325 mesh screen.

3. The composition according to claim 1 wherein the zirconium is in the dichromate form.

4. The composition according to claim 1 wherein an organic resinous binder selected from the group consisting of a synthetic resin composed of 100% reactive copolymers, polystyrene, polysulfide synthetic rubber having the formula $C_2H_4S_4$ made by the interaction of ethylene dichloride and sodium polysulfide, epoxy resins and similar liquid polymers, is present in amounts of from 5 to 10 percent by weight.

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5. A first fire and igniter composition capable of functioning under rarefied atmospheric conditions consisting essentially of, by weight, 73 to 77 percent zirconium, 18 to 22 percent sulfur, 4 to 6 percent potassium perchlorate, all of said ingredients being finely divided so as to pass through a 250 mesh screen.

6. The composition according to claim 5 wherein said composition contains 4 to 6 percent of cellulose nitrate.

7. The composition according to claim 5 wherein the zirconium is dichromated zirconium.

8. The composition according to claim 7 wherein the zirconium dichromate is sufficiently finely divided so as to pass through a 325 mesh screen.

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