METHOD OF SECRETLY MARKING A SURFACE EMPLOYING FISSION PRODUCTS

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Filed: Aug. 14, 1973

Appl. No.: 389,069

Related U.S. Application Data


U.S. Cl. 250/303, 250/304, 250/493

Int. Cl. G21h 5/02

Field of Search 250/271, 303, 304, 493

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This invention relates to a method of secretly marking or placing intelligence on the surface of an article in such a manner that the markings are undetectable by ordinary methods. This is accomplished by embedding in the surface to be marked a small amount of recoil fission products from a spontaneously fissioning radioactive isotope. These fission products have a very low radioactivity, cause no radiation damage to the article so marked, are detectable only by very sensitive radiation detectors, and the intelligence is discernible only by a radioautographic means.

5 Claims, No Drawings
METHOD OF SECRETLY MARKING A SURFACE EMPLOYING FISSION PRODUCTS

CONTINUING APPLICATION

This application is a continuation of application Ser. No. 807,083, filed Mar. 13, 1969.

CONTRACTUAL ORIGIN OF THE INVENTION

The invention described herein was made in the course of, or under, a contract with the UNITED STATES ATOMIC ENERGY COMMISSION.

BACKGROUND OF THE INVENTION

For years men have sought methods of communicating information to their friends and allies which, should the information fall into unfriendly hands, would prove unintelligible. Many of these methods are still in use today, such as the various methods of forming codes. These codes vary in complexity and the complexity of the code which is used depends upon the degree of security which is desired. However, codes can be broken, no matter how complex they are, permitting the intelligence to fall into undesirable hands.

A present-day problem is the protection of industrial equipment and personal property from those who would acquire it for their own use or for resale. Although much of this equipment is stamped with a serial number as an aid to identification, these numbers can be readily removed by those who are skilled in such art, rendering positive identification of one's own property tenuous at best.

I have developed a method which will solve both of the problems enumerated above. By my method, intelligence can be placed on a surface of a paper or similar object or a mark may be made on the surface of a piece of equipment which, even though they should fall into undesirable hands, are undetectable by any ordinary detection method. If the mark should be detected, it is unremovable from the surface short of destruction.

SUMMARY OF THE INVENTION

My method consists of embedding in the surface to be marked radioactive fission products of a spontaneous fission radioactive isotope. These fission products contain a very low level of beta-radiation action and are only detectable to one with knowledge of their presence, by extremely sensitive radiation detectors.

It is therefore one object of my invention to provide a method of imparting a secret mark to a surface, which secret mark is detectable only by sensitive radiation detectors.

It is another object of my invention to provide a method for secretly marking the surface of articles, which marking is undetectable by other ordinary methods.

It is a further object of my invention to provide a method of secretly marking equipment which, even if detected, cannot be removed from the surface short of destruction of said surface.

Finally it is an object of my invention to provide a method of marking surfaces with secret communicative intelligence, which intelligence is discernible only by radioautographic methods.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The method of this invention may be practiced by placing a spontaneous fissioning radioactive isotope close to the surface to be marked and allowing the isotope to remain in position for a period of time sufficient to deposit upon and embed beneath the surface of an adequate amount of radioactive fission products to ensure their detection by appropriate means for a period of time after removal of the radioactive isotopic source. As used herein, the term fission products is used in the sense commonly used and accepted in the art to mean various isotopes of chemical elements produced by the fissioning of a heavy atom. The term fission product is intended to mean fission product nuclide where nuclide means a specie of atom characterized by the constitution of its nucleus, i.e., by the number of neutrons and protons it contains. The term fission product is not meant to include various secondary or subatomic particles which, although they may be produced in the fissioning of an atom, are not included in the commonly accepted definition of fission products.

A number of radioactive isotopes may be used as a source of the fission products. These sources may be either spontaneous fissioning sources having a convenient half-life, such as Cm²³⁵, Am²⁴¹, Cm²⁴⁴ or Cf²⁴⁴, or it may be a source which can be induced to fission by bombardment with neutrons or other nuclear particles.

A spontaneous fissioning source, such as Cm²³⁵, which has a half-life of about 2½ years, is suitable, as it is easily transportable, does not require an outside neutron source, and has a half-life which makes it convenient for use for a considerable period of time.

This method of marking may be used on any kind of non-sticky, fairly flat surface, including magnetic recording tape and paper. The method can also be used on any sort of solid surface, such as metal.

The distance from the surface to be tagged to the radioactive source can vary from about 1.5 mm to about 4 mm. Smaller distances could cause an accidental contact with the surface with a resulting transfer of source material. Increased distances will result in increased exposure times, or lessened fission product transfer.

Only a small amount of source is necessary to tag the article as desired. Thus, about 1 microgram of Cm²³⁵ was found to be quite adequate.

The length of exposure of the surface to the spontaneous fissioning source is dependent upon the time for which detection is desired and is in direct proportion thereto. Thus, a collection time of 10 minutes from a 1 microgram Cm²³⁵ source at 1.5 mm distance is detectable by radioautographic means for up to 50 days. A one-hour collection time under the same conditions should be detectable for at least a 10-month period, while a one-minute exposure will last for 2 to 3 days.

The method of detection of the fission products is radioautography. By this method, a sheet of photographic film is placed upon the spot to be detected and exposed for a period of time before development. The length of time of exposure will necessarily depend upon the sensitivity of the film being used, the amount of fission products on the surface and the length of time since exposure. Types of film which have been found successful are Polaroid Type 47 film with an ASA rating of 3,000 and Ilford Industrial G X-ray film. Films with a high sensitivity are preferred to reduce the exposure time. Exposure times for Polaroid Type 47 film for the collection time described in the prior paragraph were 24
hours. Times other than the time given can readily be
determined by one skilled in the art.

The fission product nuclides which result from the
spontaneous fissioning of the radioactive source consist
of a mixture of radioisotopes which are beta-ray emit-
ters. Some of these isotopes, such as Br\(^{89}\) and Ce\(^{141}\),
have short half-lives, and some, such as Sr\(^{90}\) and Ce\(^{144}\),
have long half-lives. So, the radioactivities of the fission
nuclides collected will decrease at rates which become
slower and slower with time. At some time, which de-
dpends on the amount of fission products collected, after
the collection, the radioactivities of the fission products
will be so low that they present no hazard to one in
close contact with them and are undetectable by ordi-
inary radioactive survey equipment over the normal
background radiation. For example, after a 24-hour
collection, the amount of radioactivity after a cooling
period of 1 hour is 10 percent of the permissible level.

By the placement of a collimator containing a pattern
between the source and the surface to be tagged, a pat-
tern can be placed on the surface which will then be
discernible on film exposed to the surface. This, by de-
positing a suitable dot-dash pattern or other pattern
containing intelligence on the surface, the invention be-
comes a method of secret communication, which can later be
discerned only by one aware of its presence by
radioautographic techniques.

An important advantage in the use of the method of
this invention for secret communication is the built-in
self-destroying feature. That is, the information is avail-
able for recovery by my detection method for only a
specific period of time which is controlled by varying
the exposure or collection time. After this period is ex-
pired, no intelligible detection of the information will
ever be possible. Removal of the fission products from
the surface of the article is very difficult, even with de-
tergents, and organic solvents. Thus, once the article
has been marked, it will remain marked, short of de-
sroying the surface.

The following example is given as an illustration of
the process of this invention and is not to betaken as
limiting the scope or extent of the invention.

**EXAMPLE**

A Cf\(^{252}\) source that emitted \(7 \times 10^7\) fissions/minute
was deposited in a round hollow 5 mm in diameter and
1.5 mm deep. The distance between the bottom of the
hollow and an aluminum foil surface was about 4 mm.
One collimator had a hole 0.79 mm in diameter. An-
other collimator had a slot 0.4 mm wide and 6.3 mm
long. The aluminum foils with these collimators were
exposed to the Cf\(^{252}\) source for periods of time of from
1 to 10 minutes. Radioautography of the foil was made
with Polaroid Type 47 film having an ASA speed of
3,000. The exposure times varied from 0.5 to 24 hours.
For 1-minute and 10-minute collection exposures, film
exposures made 1 and 14 days after the end of the col-
lections gave clearly visible dot-dash patterns. The neg-
atives showed a much better contrast than the posi-
tives. A visible pattern was obtained for the one-minute
collection after a delay of 55 hours and a film exposure
of 2.5 days.

It can be appreciated that the method of this invention
has a great variety of useful purposes, such as marking
items of equipment documents or even random
money, for later positive identification and as a
method of secret writing.

It will be understood that the invention is not to be
limited to the details given herein but that it may be
modified within the scope of the appended claims.

The embodiments of the invention in which an exclu-
sive property or privilege is claimed are defined as fol-
lows:

1. A method of marking an article with a secret mark comprising: positioning a small amount of a spontane-
ously fissioning isotope so as to not touch the sur-
face of the article to be marked but close enough to the
surface so that the article is within the range of the radi-
active fission product nuclides emitted by said sponta-
neously fissioning isotope; maintaining said position for
a period of time sufficient to allow emitted radioactive
fission product nuclides to be transferred from the iso-
tope of the article and thereby be embedded beneath
the surface of the article; and removing said isotope.

2. The method in accordance with claim 1 wherein
the article is marked with a secret marking containing
communicative intelligence, which is discernible by ra-
dioautographic techniques, comprising: positioning a
collimator containing a pattern between said spontane-
ously fissioning isotope and said article, and maintai-
ning said collimator position until said isotope is re-
moved.

3. The method of claim 2 wherein the spontaneously
fissioning isotope is Cf\(^{252}\).

4. The method of claim 3 wherein the spontaneously
fissioning Cf\(^{252}\) is placed from about 1.5 to 4 mm
from the surface of the article to be marked, and the article
is exposed to the Cf\(^{252}\) for from 1 minute to 1 hour.

5. The method of claim 2 wherein the communicative
intelligence is discerned by placing photographic film
over the area of the article wherein the fission products
are embedded, allowing said film to remain in position
for a period of time sufficient for said radioactive fis-
son product nuclides to expose said film, and develop-
ing said exposed film.

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