Feb. 15, 1966 J. T. FERRIS ET AL 3,234,663

FILM CODING METHOD

Filed April 1, 1963 2 Sheets-Sheet 1

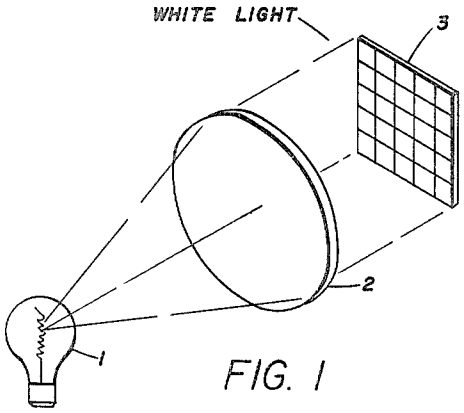


FIG. 1

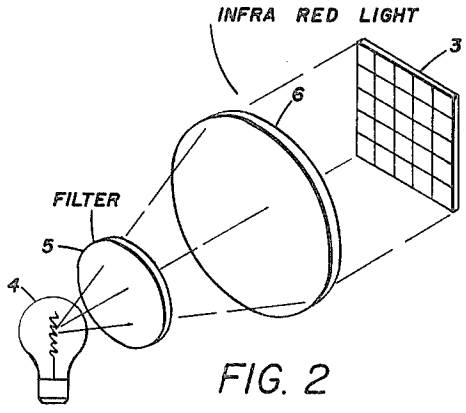


FIG. 2

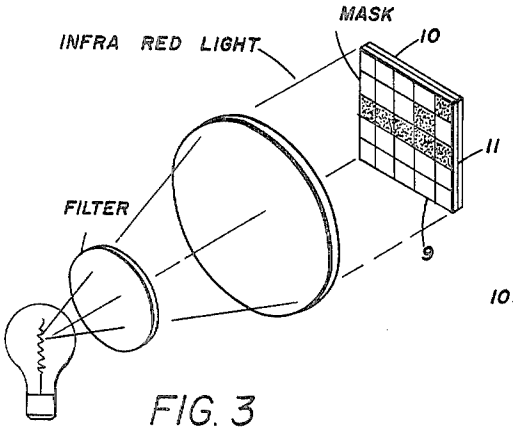


FIG. 3

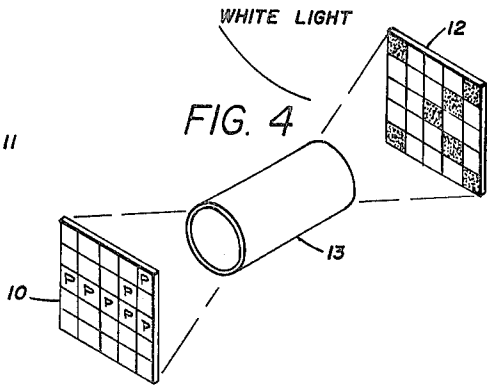


FIG. 4

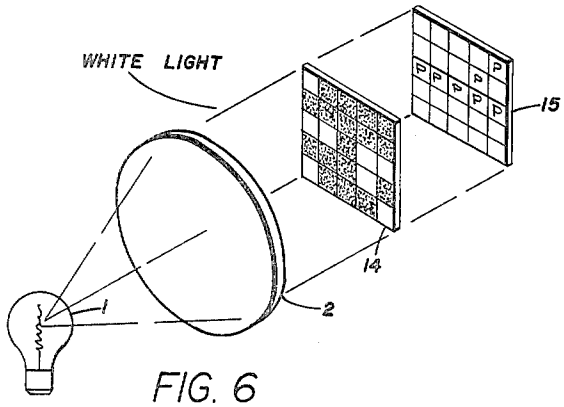


FIG. 6

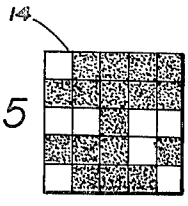


FIG. 5

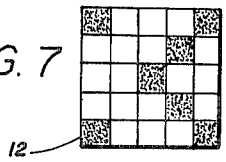


FIG. 7

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FIG. 8

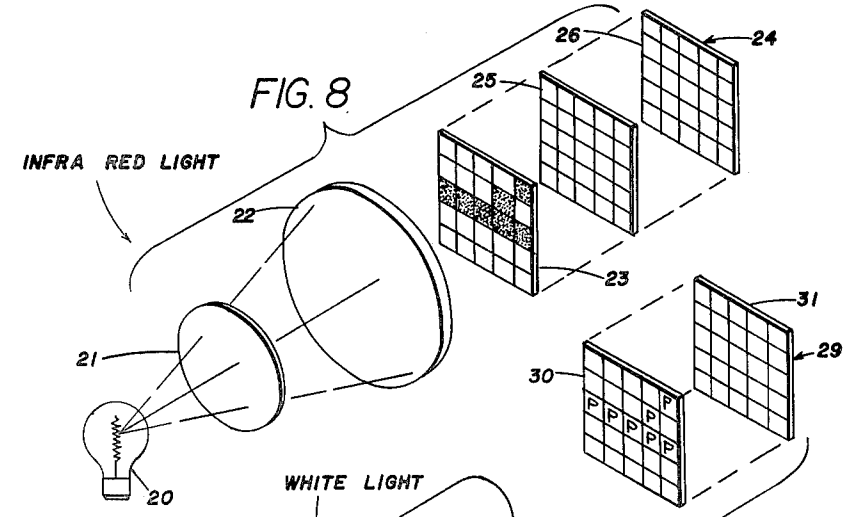


FIG. 9

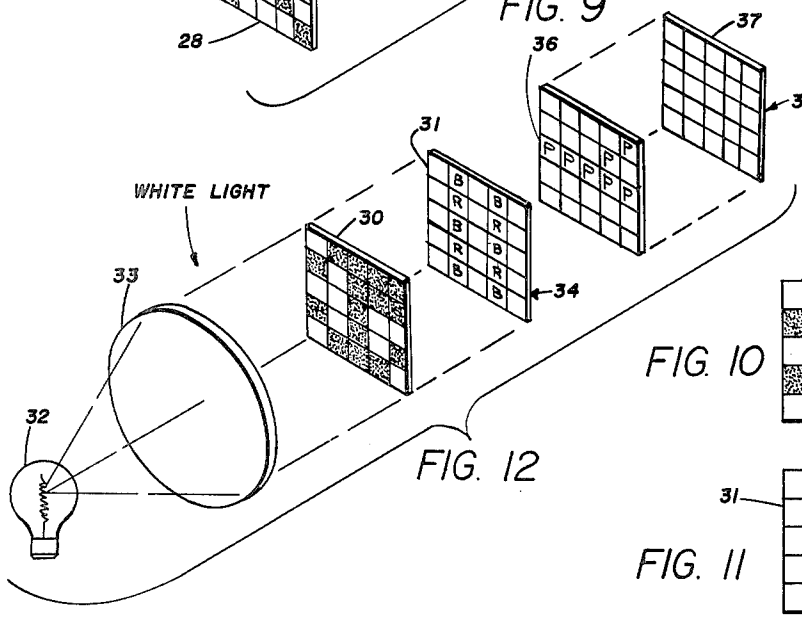


FIG. 12

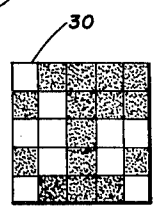


FIG. 10

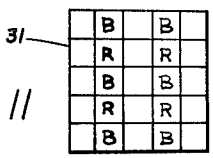


FIG. 11

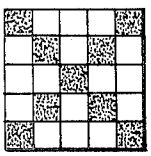


FIG. 13

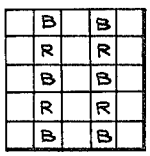


FIG. 14

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United States Patent Office 3,234,663 Patented Feb. 15, 1966

3,234,663

FILM CODING METHOD

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Filed Apr. 1, 1963, Ser. No. 269,312
6 Claims. (Cl. 35—2)

This invention relates to a coding process and more particularly to a film process for coding and decoding intelligence.

In the field of espionage, it is helpful to have a coding system whereby the intelligence carried is readable at some base point only. The intelligence might be in a form of a simple written message or of the more complex form in which a photograph is made of a scene such as an industrial or military development. If this film is intercepted prior to developing at its base laboratory, then the development would only provide a scrambling of images which are meaningless to the person developing the code.

Accordingly this invention is intended to provide such a means of carrying a code on a film. The film is processed in such a manner that a first portion is scrambled with a second portion. The first portion when exposed to an image will develop into a direct positive image and the second portion will develop to a negative image. By direct positive it is means that the portion of the film exposed to light will develop into a light portion and accordingly any dark exposed portion will develop to a black portion in the developed film. Negative films referred to will indicate a portion of the film which when exposed to white light will develop into black portions and any portions of the film exposed to black images will develop into light or transparent portions. It can be readily seen that if the portions are intermingled and finely divided that no intelligent image will develop from the film unless processed in the precise manner as set forth hereafter.

It is an object of this invention to provide a coding and decoding process whereby intelligence may be carried without being deciphered if intercepted by unwanted personnel.

It is another object of this invention to provide a means for carrying intelligence on a film which is illegible unless a rectifying process is used in the developing process.

It is a further object of this invention to provide a prepared film in which a predetermined negative portion of the film carries a portion of the intelligence of a prescribed message and develop into an illegible message unless a rectifying exposure is used on an identically prepared film prior to development of the second film.

The objects of this invention are accomplished in a manner whereby a special black and white film is used or a color film is used in which specific precoded portions of the film are processed in a manner that they develop into an illegible signal unless the rectifying exposure is directed on the film prior to development. As an example, E. I. Du Pont de Nemours and Company manufactures a film such as Cronaflex direct positive film which has been exposed to a white light over its entire area. This converts a negative type film to a direct positive film. There are other films on the market which if processed properly will produce the same results. Two films are then exposed to an infrared light of a precisely measured intensity and time whereby portions of the film are partially nullified causing the film then to develop to a gray image and causing the film to readily change to direct positive or negative type. Subsequent to this infrared exposure a mask is placed over the films, an infrared light

is then directed through the mask on the films and completely nullifying portions of the white light exposure of the film as it comes from the manufacturer. The portion of the film exposed to infrared light through transparent portions of the mask invert to negative film and the portions behind black portions of the mask remain direct positive. This mask determines the portions of the films which when developed will go to a direct positive or a negative.

The film is then placed in a camera and the message is impressed on the film. Upon developing of the exposed film the positive and negative code matrix of the first film is superimposed over the mating matrix of the second film and an image is projected on the second film which reverses portions of the second film in a manner so the total film will then develop in a manner simulating a direct positive, or a negative film and thereby provide a message which is legible upon development. This is possible only in the laboratory in which the initial code is made. The code may be changed from day to day to further confuse and prevent interception and deciphering of the code by unwanted personnel.

Referring to the drawings two variations are shown which illustrate the preferred embodiments of this invention. The original embodiment uses a black and white film while the modification illustrates a black and white and colored film combination for this code.

FIG. 1 illustrates the initial exposure of the film to white light which may be done by the manufacturer or in the laboratory.

FIG. 2 illustrates a limited exposure to infrared light to partially nullify the white light to exposure.

FIG. 3 illustrates the exposure to infrared light through a mask to control the code impressed on the film.

FIG. 4 illustrates the exposure of the film in a camera to an obect.

FIG. 5 illustrates the film exposed as in FIG. 3 and directly developed.

FIG. 6 illustrates the exposure of the second film prepared in FIG. 3 as masked by the developed film of FIG. 5.

FIG. 7 illustrates the film exposed in FIG. 6 which is developed and an image of the object of FIG. 4.

FIG. 8 illustrates the exposure of a black and white film and colored film through the mask by the use of infrared light.

FIG. 9 illustrates the film prepared in FIG. 8 being exposed to an object.

FIG. 10 illustrates the black and white film developed subsequent to exposure in FIG. 8.

FIG. 11 illustrates the colored film exposed in FIG. 8 and developed.

FIG. 12 illustrates the film developed in FIGS. 10 and 11 operating as a mask for exposure of white light to the second film prepared in FIG. 8 prior to the final developing of the second film.

FIGS. 13 and 14 illustrate the film subsequent to the rectifying exposure which is developed to illustrate the object in FIG. 9.

Referring to the FIG. 1 the step as illustrated may be preformed in the laboratory or on the film prior to purchasing from the supplier. The film initially is what is known as a negative film and if exposed to the image would develop in a negative manner where light portions would develop dark and dark exposed portions would develop light. The white light exposure is controlled and has the effect on this type of film when controlled in the manner as illustrated to provide a reversion. This type of a film when exposed as illustrated will revert to what is known as a direct positive film.

FIG. 2 illustrates the film which has been exposed

to white light in FIG. 1 which is then subjected to a controlled exposure of infrared radiation. The film will remain at a direct positive type but will be readily convertible to the negative type of film.

FIG. 3 illustrates the manner in which portions of the films may be converted to a negative type film in predetermined portions in accordance with the predetermined code. This code may be changed at will but the pair of films must be identified. The mask permits infrared radiation to pass through the mask in transparent regions and to be blocked by the opaque regions to thereby place the code on the film. For the purpose of illustration the film is divided into 25 squares. A number of these squares are opaque and the remaining ones are transparent, however, the particular configuration of the opaque areas relative to the transparent areas is not limited but illustrative. The areas might be very minute and scrambled relative to each other to prevent any discernible intelligence from the film if intercepted by unwanted personnel and developed at this point.

Two films are prepared in a like manner with the use of the mask. Neither of these films are developed at this point.

One of the films is then inserted in a camera and may be used at any place to receive an image of whatever intelligence is desired. The film in the camera is identified with the second of the two films. The second film however, is placed in a laboratory for safe keeping and is not developed but retained for some future date when it is re-exposed by a subsequent step in the overall process.

The film that is inserted in the camera is then exposed in a manner as illustrated in the FIG. 4. The first of the films **10** is the same film as illustrated in FIG. 4. The film **10** is exposed to the object **12** by a photographic lens system **13** which is non-reversing and non-inverting. This type of a lens system is used only for the purpose of this illustration but is not limiting in the type of lens which may be used. The object **12** illustrated is directed through the lens system **13** onto the film **10** in the same position as shown on the object. The film as exposed through the mask **9** has a plurality of direct positive squares as indicated by "P." The object **12** is imaged on the film which is subsequently developed. Due to the preceding steps in the preparation of the film, the film as developed when exposed to the object **12** will be as illustrated in FIG. 5. It is obvious that no intelligence is legible on the film as developed.

The film is a black and white film and is developed as shown and then used in another step of the process as illustrated in FIG. 6. The source of white light **1** is then directed through a collimating lens **2** through the developed film **14**. The second of the two films which were prepared in FIG. 3 is the film **15** in FIG. 6. The developed film **14** is placed with one of its major surfaces contacting the major surface of the undeveloped film **15** to direct the light accurately through both films. The film **15** is undeveloped but has portions marked with the letters "P" which are direct positive areas. The white light projected through the collimating lens **2** passes through the developed film **14** and then onto the undeveloped film **15**. Subsequent to this exposure the film **15** is then developed as shown in FIG. 7.

The developed film **14** permits light to pass through and expose film **15** to an image of the developed film **14**. Portions of the film **14** are direct positive and other portions are negative. Due to the specific arrangement of the opaque areas certain portions of the negative film are caused to receive a negative image through the film and positive portions of the film are similarly caused to go to positive images. The combination of the two gives the overall effect of developing into the image of the object **12** as illustrated in FIG. 7.

Referring to FIGS. 8 through 14 a modification is

illustrated wherein color film is used in combination with a black and white film. The colored film is designed to be used in combination with the black and white for high contrast illumination. The coloring combination serves primarily as a background to confuse. The sizes of the grains in the film are comparable to the intelligence to be received on the film.

The film in this modification is first prepared as in FIG. 2 with an overall precise infrared exposure. Referring to FIG. 8, a source of illumination **20** is directed through an infrared filter **21** and the collimating lens **22**. The mask **23** is positioned intermediate the collimating lens **22** and the composite film **24**. The mask carries the code to be inscribed on the black and white layer **25** and the dyed layer **26** which carries the color in the composite film **24**. The black and white layer **25** of the composite film **24** is a film similar to the film initially described which is prepared by the infrared light as shown in FIG. 2. The layer **25** of the composite film **24** is initially a direct positive film and portions of the direct positive characteristic of this film are nullified by the infrared exposure at this point. The portions of the film which remain of the direct positive type are those which are covered by the mask **23** as the film is exposed to the infrared light. The colored portion of the unmasked film carrying red and blue areas are of minute size and change color from exposure from red to blue and from blue to red. Two composite films **24** are prepared by a step in this manner. The one film is placed in a camera which is then ready to receive information in the field. The second film is placed in a laboratory undeveloped and identified as the mating film for the first film which was inserted in the camera.

The film in the camera is then exposed through a photographic lens system **27** which is non-reversing and non-inverting and directs an image of the object **28** to the black and white layer **30** and the colored layer **31** of the composite film **29**. The films **30** and **31** are then developed as illustrated in FIGS. 10 and 11. The red and blue may develop as shown although the selection of proportions and pattern of red and blue in FIG. 11 is illustrative only.

FIG. 10 illustrates the portions of direct positive and negative film of the layer **30** which has been exposed to the object **28** and then developed. The developed film shows no relationship to the object **28**. This is due to the fact that some portions are direct positive type of film and others are of negative type of film.

The composite film **29** including layers **30** and **31** which is then developed are placed in the path of collimated white light from the source of light **32** directed by the collimator **33**. The collimated light upon transmission through the composite developed film **34** then is projected through the composite film **35** which comprises a black and white layer **36** and the dyed layer **37**. The layers **36** and **37** carry the identical code of film types as the layers **30** and **31** of FIG. 9. The transmission of light through the composition film **34** is partially blocked due to the opaque areas in the black and white film. The image developed on the composite film **35** is identical with the object **28**. As the film layers **36** and **37** are developed they are shown as illustrated in FIGS. 13 and 14. The image of the black and white film in FIG. 13 is identical with the object **28** of FIG. 9. The background colored film as developed in FIG. 14 is merely background which is confusing and does not carry any intelligence. It is possible to use a varying proportion of the red and blue to change the apparent effect of the background and also through the use of filters in observing of the developed film, a special contrast may be emphasized or de-emphasized in looking at the finished film.

Referring to the FIGS. 1–7 the black and white film process is described in the following paragraphs.

A white light radiating from the source of illumination

1 is directed through the collimator 2 and equally distributed over the surface of the film 3. This exposure to white light creates a direct positive film. The film of this type may be purchased from the supplier if desired and thereby eliminating the step shown in FIG. 1.

FIG. 2 illustrates a step in which a limited degree of infrared radiation is directed over the entire surface of the film 3. The source of illumination 4 radiates through the filter 5 and the radiation is collimated by the collimator 6.

The next step comprises radiating two films 10 by the use of a mask 9 to limit the degree of radiation on the prescribed areas in accordance with a code. The opaque areas of the mask 9 block the radiation which permit these areas which are covered by the opaque areas to remain direct positive in effect. The areas which are transparent in the mask permit radiation to be transmitted through the film 10 and thereby completely nullify the portions of direct positive type film in these areas. Two films are prepared in this manner of which one is inserted in a camera and the second is identified and kept in a laboratory.

FIG. 4 illustrates exposure of the film to the object 12 through a non-reversing, non-inverting lens. The film is then developed and results in a film as illustrated in FIG. 5. The developed film in FIG. 5 is placed intermediate a source of illumination and a collimator, and the film 15 which was stored in the laboratory. The result is an exposure of all areas to rectify the final image to simulate the object. Upon developing the film develops as illustrated in FIG. 7 which is identical with the object 12 of FIG. 4. The process gives a means of obscuring intelligence carried on the film if developed at some point other than the laboratory of the initial preparation of the film.

Referring to the modification illustrated on FIGS. 8–14 at least two films are exposed in a manner as illustrated in FIG. 2. The films are then masked as indicated in FIG. 8 causing a complete nullification of portions of the films not covered by the black portion of the mask. The portions covered by the black portions of the mask remain unaltered and of the direct positive type. One of the films prepared in this manner is then placed in a laboratory and identified with the second film prepared in this manner. The other film is placed in a camera and exposed to an object or some form of intelligence as shown in FIG. 4. Subsequent to exposure of this film the film is developed and then used as a mask over the film which was stored in the laboratory. A white light exposure is then directed through the developed film mask which superimposes the coded areas on the unexposed of the two films and an image is projected from the masked film to the unexposed film. Upon subsequent development of the exposed film the intelligence received from the object is then legible as the film is developed. The red and blue bits in the film serve to confuse the real image of the intelligence carried on the film and revert from red to blue and blue to red to further confuse the deciphering by unwanted personnel.

The process set forth in the preceding description and illustration is the preferred embodiment of this invention. The modifications of this invention might be devised which would fall within the scope of this invention which is defined by the attached claims.

We claim:

1. The method of impressing and reading intelligence on a film comprising the steps, radiating at least two direct positive reversible type films with infrared radiation through a mask and causing a reversion of identical portions of the film to negative type and permitting portions to remain of the direct positive type, exposing one of said films to intelligence and subsequently developing said film, masking the undeveloped film with said developed film and exposing said undeveloped film with white light through said developed film, developing said undeveloped film to provide a film carrying the readable intelligence.

2. The method of coding and decoding an intelligence on a film comprising the steps, radiating at least two reversible films with infrared radiation and identically codifying said film whereby first portions react negatively and second portions react positively when exposed to white light, exposing at least one of said films to intelligence through a white light impression, developing said exposed film, masking said unexposed film with said developed film and exposing said undeveloped film through said developed film to white light radiation, and subsequently developing said undeveloped film to provide a readable intelligence signal as previously exposed on the first of said films.

3. The method of codifying and decodifying an intelligence message on a film comprising the steps, radiating two reversible type negative films with white light to produce a direct positive type film, subjecting at least two films to infrared radiation and identically codifying said films whereby first portions of said film to react negatively relative to second portions which react positively upon exposure to a white light intelligence, exposing one of said films to intelligence by white light radiation, developing said exposed film and masking said undeveloped film with said developed film, exposing the undeveloped film through said developed film to a white light radiation thereby causing all portions of said undeveloped film to react in a manner similar to a direct positive exposure of the first of said films as initially exposed to the white light intelligence.

4. The method of codification and decodification of a film comprising the steps, radiating two reversible type negative films with white light to produce a direct positive type film, exposing at least two films through a codified mask to infrared radiation and causing identical portions of both of said films to react negatively and the other portions positively, exposing the first of said films to a white light signal and developing said film, masking the second of said films with the exposed and developed film to cause said second film to react in a positive manner and reproduce the white light signal impressed on the first film.

5. The method of concealing and deciphering intelligence on a film comprising the steps, irradiating with white light two negative type black and white films having color sensitive bits to convert the films to a direct positive type, irradiating said two films with infrared radiation and causing the same portions of each of said films to react negatively and positively respectively, exposing one of said films to intelligence to be carried on said film, developing said exposed film and masking said unexposed film with said developing film during radiation to white light, subsequently developing the undeveloped film to decipher the intelligence carried on said first film and show a colored background.

6. A method of concealing and deciphering intelligence on a film comprising, irradiating with white light two composite films of black and white carrying color bits to convert said film to a direct positive type, irradiating said two films with infrared radiation and codifying said film whereby identical portions of said films react negatively and positively respectively, exposing one of said films to intelligence, developing the exposed film, exposing the undeveloped film through a mask of said developed film with white light radiation, subsequently developing and thereby deciphering intelligence on said undeveloped film.

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