

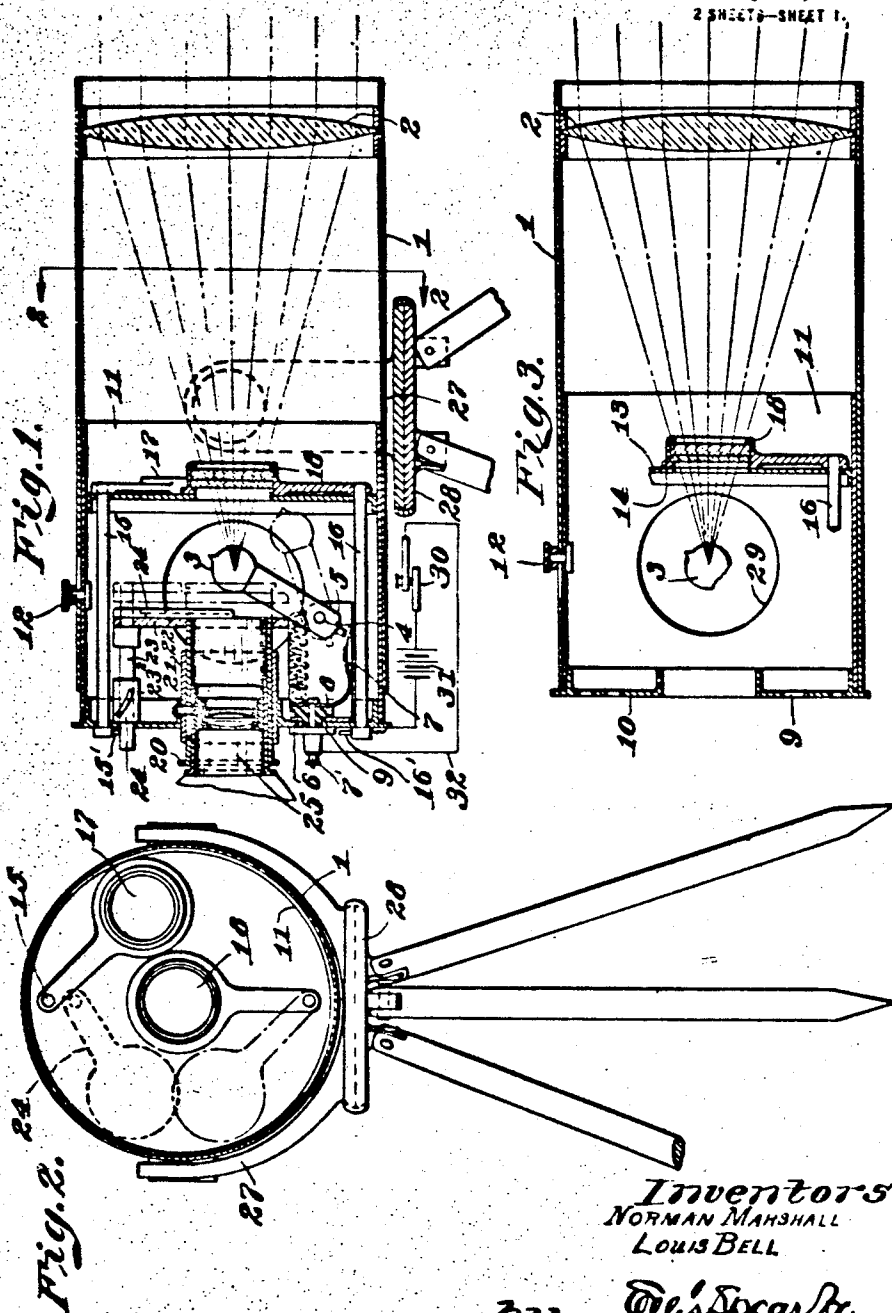
N. MARSHALL AND L. BELL.

METHOD AND APPARATUS FOR UTILIZATION OF OBSERVABLE RADIATIONS.

APPLICATION FILED FEB. 1, 1919.

1,385,696.

Patented July 26, 1921.



Inventors
 NORMAN MARSHALL
 LOUIS BELL

by *W. S. Spear Jr.*
 Attorney

N. MARSHALL AND L. BELL.
METHOD AND APPARATUS FOR UTILIZATION OF OBSERVABLE RADIATIONS.
APPLICATION FILED FEB. 1, 1919.

1,385,696.

Patented July 26, 1921.
2 SHEETS—SHEET 2.

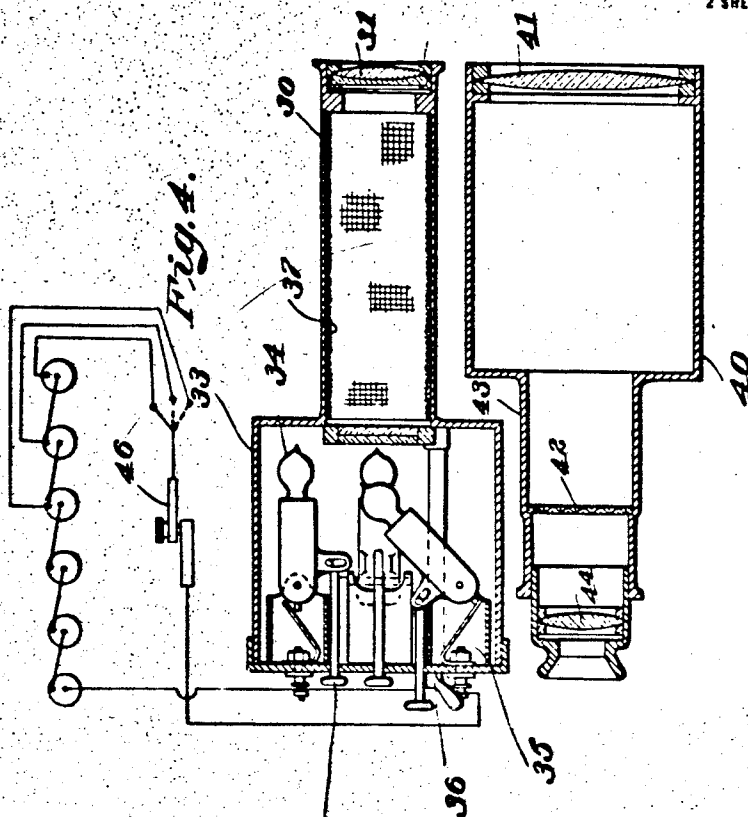
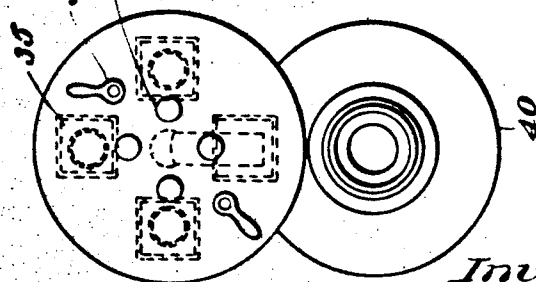


Fig. 5.



Inventor
NORMAN MARSHALL
LOUIS BELL

by *W. S. S. Co.*
Attorney

UNITED STATES PATENT OFFICE.

NORMAN MARSHALL AND LOUIS BELL, OF WEST NEWTON, MASSACHUSETTS.

METHOD AND APPARATUS FOR UTILIZATION OF OBSERVABLE RADIATIONS.

1,385,696.

Specification of Letters Patent. Patented July 26, 1921.

Application filed February 1, 1919. Serial No. 274,518.

To all whom it may concern:

Be it known that we, NORMAN MARSHALL and LOUIS BELL, citizens of the United States, both residing at West Newton, county of Middlesex, Commonwealth of Massachusetts, have invented certain new and useful Improvements in Methods and Apparatus for Utilization of Observable Radiations, of which the following is a specification.

This invention relates to signaling, observation and the like by rays ordinarily invisible, and is especially adapted for use in war where operations are being conducted in the presence of the enemy.

Our invention is founded upon the fact that there are radiations from a source of high temperature such as an arc or incandescent lamp at either side of the visible part of the spectrum. That is, of shorter and longer wave lengths than the visible spectrum. The radiations at either side of the visible spectrum while invisible themselves, follow generally the laws of reflection and refraction of visible light, and produce various fluorescent, chemical, electrical and other physical effects which can be detected by suitable receiving apparatus.

In carrying out our invention we project a beam of such rays to a distant point where it is collected, reflected or refracted for observation.

Convenient apparatus in accordance with our invention is set forth in the specification which follows, and the same illustrated in the accompanying drawings to which reference is made. In the drawings:

Figure 1 is a longitudinal sectional view of a combined receiving and transmitting instrument in accordance with our invention.

Fig. 2 is a transverse section of the same on the line 2—2.

Fig. 3 a section similar to Fig. 1 but with parts removed and in fragment to illustrate adjustment for wide beam projection.

Fig. 4 is a modified form of receiver and transmitter, and

Fig. 5 is an end view of the same.

There have been many difficulties in the utilization of radiation which by our invention have been avoided or overcome. Such difficulties are, for instance, the obtaining of a beam of suitable intensity from a source practicable for use in the functions heretofore stated; in the difficulty of pro-

viding receiving apparatus of sufficient sensitiveness without being at the same time easily disarranged and uncertain of function; and above all providing both sending and receiving apparatus sufficiently portable for the practical operation of observation and signaling.

Many substances are extremely opaque to invisible rays or reflect them badly, and others, which are free from these difficulties, are practically unobtainable or unusable on a practical scale. For instance, quartz and fluorspar are notoriously transparent to ultraviolet, but neither of them can be had readily enough or in pieces of sufficient size to render their use practicable. Rock salt, the substance most commonly used in the infra red portions of spectra on account of its great permeability to such rays, is extremely sensitive to moisture, and hence out of the question for military purposes.

To certain groups of invisible rays, which might otherwise be desirable, glass is quite opaque, and with certain others, refracting substances are undesirable because they absorb badly. Moreover, certain groups of rays in themselves are undesirable for practical use because they are quickly absorbed by the atmosphere, or are obtainable in quantity only from sources not convenient for general use. We have found therefore that each range of invisible rays presents its specific difficulty in generation, selection, sending and reception, and it is the object of our invention to adapt each to each so as to produce a method and apparatus for the utilization of invisible radiation of a simple, practical and efficient character.

The beam whether direct or reflected should be suitably concentrated by reflection or refraction and may then be received upon devices possessing high sensitiveness with respect to the particular group of radiations concerned. It may for instance be received upon a fluorescent screen and thereby made immediately optically visible.

We have found that, particularly for signaling purposes, a large part of the invisible range of radiations is ill adapted for one or the other of the reasons here suggested, and our preferred range of radiation for this purpose consists in those radiations lying between 400 μ and 350 μ wave length, which are just too short to be ordinarily visible to the human eye, and not yet short enough to be suppressed by suitable

glass or ordinary refracting or reflecting media.

The group of radiations here referred to is relatively easy to isolate in practical quantity, since it can be screened out from the rest of the spectrum by suitable vitreous colored screens of relatively simple character.

We preferably use a double screen of superimposed plates one taking out the blue and violet and one the red. For the former we prefer a glass deeply colored with nickel permeable for rays between 400μ and 350μ but which cuts off the visible spectrum down to the red end. The other glass is a green copper glass quite permeable to the rays noted as desired, but opaque to the red end of the spectrum.

The ranges of absorption of these two glasses slightly overlap but not in the band between 400μ and 350μ . The result is a maximum in the desired suppression with a minimum effect on the desired transmission.

Furthermore, and of great practical importance we find by experience that this particular range of radiations is easily obtainable from incandescent electric lamps or similar incandescent source, giving a source of energy at once steady, efficient and convenient, and particularly adaptable to portable use. Experimental work on ultra-violet radiations has been heretofore confined almost exclusively to sources especially rich in extreme ultra-violet, sources such as highly specialized electric arcs, involving the use of iron or other metallic terminals, or by use of such sources as vacuum tubes and mercury arcs, possessing the same characteristics. These sources are none of them convenient for field use; most of them are unsteady and require the use of highly specialized electrical sources involving voltage not readily obtainable of sufficient strength in portable appliances.

The incandescent lamp also permits of an easy adjustment of range of the beam by raising or lowering the voltage of the current used. For short ranges or dark nights, visibility is decreased by lowering the current while for longer ranges or brighter nights the lamp may be forced on a higher current. This is conveniently accomplished by cutting in extra cells in the battery carried with the signal instruments as shown in Fig. 1.

The specified group of radiations which we prefer to use is free from these objections and is of extremely low visibility. A concentrated beam of this character is completely invisible in its passage through the air, and invisible also to direct view beyond extremely short distances, compared with that at which it may be detected by means which we have provided and that meet all the practical requirements of an invisible signaling apparatus. In receiving such a

beam, it can be concentrated through glass lenses without serious loss of intensity, even non-achromatic lenses being suitable on account of the comparatively narrow range of wave lengths.

The fluorescent eye piece as applied to spectrosopes in which the beam is spread out on a prism has long been known, but so far as we are aware no attempt has been made to produce a concentrated fluorescent image upon a fluorescent screen of any kind for purposes herein described.

We have discovered moreover that the most reliable and sensitive fluorescent screens are radically different from those heretofore used in fluorescent eye pieces. We prefer to employ for this purpose translucent or opaque films of material giving a greenish fluorescence when in a solid condition. We therefore use a translucent film of such material as barium platino cyanid deposited on some transparent material and viewed from the rear or compacted into an opaque screen and viewed from the front upon which the light falls.

In order to make more clear the actual practice of our invention we have shown in the drawings as illustrative of means for practicing our invention, certain apparatus adapted for field use.

For convenience in field work, we provide a combined ray projector and receiver adjustable for narrow or wide ray, which consists of a suitable mounting, consisting of a tube 1, fitted with an objective 2 and a movably mounted source of light 3, pivoted at 4 within a bracket 5 and normally held with its filament in the focus of the objective 2 by a spring 6. (See Figs. 1 and 3.)

The lamp socket makes contact with a leaf 7 insulated at 8, the other terminal being grounded in the mounting 1. The bracket 5 is adjustably held in a slot 9 in the recessed wall 10 of a mounting section 11. When in the position shown in full lines in Fig. 1, the filament of the incandescent lamp 3 is in the focus of the objective 2 and the circuit is closed. When in the position indicated in dotted lines the circuit is broken.

The section 11 is slidable within the main mounting tube 1 and is adjustably held by a slot and bolt at 12. At its forward end the section 11 has a front wall 13 in which is a central opening 14 in the axis of the objective 2.

Journalled near each of their ends in a rear wall 10 and front wall 11 are rock shafts 15 and 16. The shaft 15 carries on a short arm, of proper length to cover the opening 14, a ray filter 17 for screening rays during receiving. The shaft 16 carries on a similar arm, a similar filter 18, but somewhat more dense, for use in sending. Both shafts are rocked by means of short handles 15' and 16' to throw the screens 17 and 18 into or

out of registry with the opening 14 to selectively screen the rays passing through it.

The sliding adjustment of the section 11 permits the shifting of the filament of the lamp 3 relative to the objective 2 in order to provide for a divergent beam as illustrated in Fig. 3. This is sometimes desirable in sending in order to assist the receiving station to pick up the beam when it has not been possible to get the instruments accurately aligned.

Through the rear wall 10 of the section 11 is slidably fitted an eye piece tube 20 in a fixed tube 21 fast in the rear wall and acting to guide and steady the eye piece tube.

The tube 20 carries at its outer end a collar 22 extended upward to form a bearing for a rock shaft 23 which has on its outer end an arm 24.

The arm 24 carries the fluorescent screen which as above described is preferably a barium platino cyanid film upon which the incident rays received produce a greenish fluorescence. When in the position shown in Fig. 1, the arm 24 is in its lateral position indicated in dotted lines in Fig. 2. When the tube 20 is pushed forward the lower end of the collar 22 contracts with and pushes down the socket of the lamp 3. As the tube 20 nears the vertical plane originally occupied by the lamp filament, the shaft 23 is rocked by reason of the travel of the pin 23¹ in the slot of the guide 23², fixed on the rear plate 10. The movement of the tube 22 therefore not only removes the lamp but brings the fluorescent screen in the vertical plane of the focus of the objective and across its axis behind the opening 14.

Within the eye piece tube 20 is the eye piece proper 25 which with its lens cell 26 is held by a screw in the wall 10. The eye piece lens is therefore held at its proper point, the tube 20 being slotted to pass the screw in its longitudinal movement.

The mounting 1 is carried on a trunnion mount 27, which again is rotatable in a horizontal plane on its tripod 28. The mount section 11 is cut out at 29 to provide access to the lamp 3 for replacement.

The insulated spring 7 is connected up by a binding post 7¹ with a key 30 and battery 31 by a line 32 which is given electrical connection to the mounting 1.

When operating as a transmitter as shown in Fig. 1, the lamp filament is at the proper focal length from the objective 2 to give projected parallel rays. When a divergent beam is required the section 11 is pushed in and clamped as shown in Fig. 3. In each case the heavy transmitter filter 18 is interposed between lamp and objective and the beam reduced to practical invisibility.

The light so projected and screened is varied by interruption through a key 30 to produce intelligible signals which are re-

ceived by a similar instrument set for receiving by pushing in the eye piece slide 20.

The slide 20 in being pushed in turns down the lamp 3 to the position shown in dotted line in Fig. 1, the fluorescent screen 70 at the same time being interposed as indicated so as to observably receive the concentrated rays focused by the objective.

Signaling in accordance with our invention may be successfully carried on over considerable distances and with practical safety from detection or observation. The devices described above as illustrative of our invention may be modified in various ways without departing from the spirit thereof as in the form shown in Figs. 4 and 5.

In these figures the sender is independent of the receiver though preferably mounted together on parallel axes.

In this form the sender consists of a tube 30 fitted with an objective 31 and aligned with the opening 32 of the casing 33. In this casing 33 we have shown a plurality of light sources 34 each similar to the single lamp 3 shown in Fig. 1 and each capable of being independently moved to or from the focus of the objective 31. In this manner lamps may be quickly shifted without the delay of replacement or any break in signaling operation. Each lamp is pivoted at 35 and controlled at 36. The filter screen 37 is mounted within the tube 30 to cover or uncover the opening 32 as in Fig. 1.

In this form the sending objective 31 is smaller and the receiving objective 41 in its mounting 40 considerably larger and focuses on a fluorescent screen 42 in an eye-piece tube 44, which is slidably adjustable in the section 43. The pair as shown make a compactly mounting assembly while maintaining axial parallelism as shown in Fig. 5.

Both of these embodiments while practical and convenient may obviously be modified in form and structure and by the substitution of equivalent elements or parts, all without departing from the spirit of our invention if within the limits of the appended claims.

What we therefore claim and desire to secure by Letters Patent is:

1. In signal apparatus of the class described, a combined projecting and receiving device comprising an objective and an eye piece, a source of radiant energy and a fluorescent medium both mounted in selective operative relation to said objective and a ray filter in inclusive association with said related parts.

2. A combined projector and receiver of the class described comprising a mounting, an objective set therein, a mounting section adjustable relative to said objective, a ray filter carried by said mounting section and adjustable therewith, an eye piece adjustable in said mounting section, a source of

radiant energy and a fluorescent medium each movable in selective relation to said objective.

3. A combined projector and receiver of the class described comprising a mounting tube, an objective set therein, a slide tube adjustable relative to said objective, a ray filter carried by said slide tube and adjustable therewith, an eye piece slidably adjustable in said mounting section, a source of radiant energy and a fluorescent medium each movable in selective relation to said objective.

4. A combined projector and receiver of the class described comprising a mounting, an objective set therein, a mounting section adjustable relative to said objective, an eye piece adjustable in said mounting section, a fluorescent screen carried on the end of said eye piece, means for moving said screen into and out of alinement with said eye piece upon the adjustment thereof, a lamp mounting pivoted in said section, means for yieldingly holding said mounting in the path of adjustment of said eye piece, a ray filter movably carried on the forward end of said mounting, and means for changing the interceptive relation of the ray filter to said objective.

5. In a combined projector and receiver of the class described, an objective, a source of radiant energy and a fluorescent medium both mounted in selective operative relation to said objective and a plurality of ray filters, one of said filters being movably mounted.

6. In a signal system, an incandescent light bulb as a source of radiant energy, a filter excluding blue and violet rays but permitting the passage of ultra violet between 400 μ and 350 μ , a second screen excluding the rays of the visible spectrum transmitted by the first screen by permitting the passage of the hereinbefore mentioned ultra-violet rays, a projector for directing the light in a beam, a control for interrupting the light and a receiver including a screen having a fluorescence responsive to said ultra violet rays.

7. In a signal apparatus, a transmitter including means for projecting a directed beam of rays from that band in the ultra-violet zone lying next adjacent the visible spectrum, and a receiver including a screen having a greenish fluorescence under said rays.

8. In a signal system, a source of radiant energy having a vitreous inclosure, a filter including blue and violet rays but permitting passage of ultra-violet between 400 μ and 350 μ , and a second screen excluding the rays of the visible spectrum transmitted by the first screen by permitting the passage of hereinbefore mentioned ultra-violet rays, a projector for directing the light in a beam,

a control for interrupting the light, an image receiving screen having a fluorescence responsive to said ultra-violet rays, a lens for focusing the received beam on said screen and eye piece for observing said screen.

9. An apparatus for observable utilization of invisible rays from that band in the ultra-violet zone lying next adjacent the visible spectrum and comprising a source of radiant energy, concentration, projection and ray selection devices operatively associated therewith for the projection of the desired selected and directed beam, and an observational device including a fluorescent medium for collective visualization of the transmitted radiant energy.

10. Apparatus for observable utilization of invisible rays from that band in the ultra-violet zone lying next adjacent the visible spectrum and comprising an incandescent source of energy, a concentrator for the beam thereof, a blue green filter, screen disposed in the path of said beam, means for predeterminedly interrupting said beam, and an observation device adapted to be disposed in the path of said beam comprising a fluorescent screen, and an eye piece for observing the fluorescence of said screen under the action of said rays.

11. In a signal system for observable utilization of invisible rays from that band in the ultra violet zone lying next adjacent the visible spectrum, a sending and receiving device, a projecting and receiving lens, an incandescent lamp movably mounted in said projector and positionable with its filament at the focus of said lens, a fluorescent screen movably mounted in said projector in interchangeable relation to said lamp filament at said focus, an eye piece focusable upon the image of said lens, and a ray filter removably mounted in the axis of said projector.

12. In a signal system employing predetermined radiations of low visibility from that band in the ultra-violet zone lying next adjacent the visible spectrum, a receiver consisting of means for concentrating such transmitted predetermined radiations, a fluorescent screen at the point of concentration sensitive to such radiations, a filter cover for said screen excluding all but the predetermined radiations of said transmitted beam and an eye piece mounted for observations of said fluorescent screen.

13. In a signal system for observable utilization of invisible rays from that band in the ultra violet zone lying adjacent the visible spectrum, a sender and a receiver, projecting and receiving instrumentality including an incandescent lamp operatively mounted for projection, a fluorescent screen operatively mounted for receiving, an eye piece focusable upon the image of said lens

on said screen and a ray filter mounted in the axis of projection.

14. In a signal system employing predetermined radiations of low visibility from that band in the ultra-violet zone lying adjacent the visible spectrum, a receiver consisting of a lens for concentrating such transmitted predetermined radiations, a fluorescent screen at the focus of said lens and sensitive to such radiations, a filter for said screen and excluding all but the predetermined radiations of said transmitted beam and an eye piece mounted for observation of said fluorescent screen.

15. In a signal system, a sending and receiving device, a projecting and receiving

lens, an incandescant lamp movably mounted in said projector and positionable with its filament at the focus of said lens, a fluorescent screen movably mounted in said projector in interchangeable relation to said lamp at said focus, a stronger ray filter movably mounted in the optical axis of said device, and a weaker ray filter movably mounted in said axis.

In testimony whereof we affix our signatures in presence of two witnesses.

NORMAN MARSHALL.
LOUIS BELL.

Witnesses:

VICTORIA LOWDEN,
GEORGE B. RAWLINGS.