
DIV.16-421-M1
DEVELOPMENT OF INFRARED TELESCOPE

CONFIDENTIAL

Research Laboratories
June, 1942
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FDRC-269

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Research Laboratories
RCA Manufacturing company, Inc.,
Camden, New Jersey
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1. Introduction

The investigation of infra-red and its applications has continued along the lines of improving the infra-red image tube, developing new driving equipment and working out spotting devices.

1. The image tube development included some work on high voltage image tubes, the design of a satisfactory small image tube, and research towards improving the sensitivity of infra-red photosensitive cathodes.

2. A number of projects are being undertaken in connection with the driving of various vehicles where infra-red is the sole source of illumination. Tests are in progress on the driving of an infra-red equipped Station Wagon and of a similarly equipped tank. The necessary equipment for a special infra-red truck and a military vehicle known as the "Weasel" is being designed and constructed.

3. Experimental work on various spotting devices is being carried out. This involves constructing telescopes whose overall sensitivity is high, and therefore, deals with tube response, optical systems, etc. A hand telescope with interchangeable lenses has been built for use as a spotting instrument and two Schmidt systems are under construction.

4. Some work has been done on infra-red sources, both for driving and spotting. This includes the placing of driving lights, searchlight tests and filter designs.

II. Development of Image Tube for easily portable viewing equipment has been the subject of considerable work. The building and processing of about thirty small tubes has been required to establish satisfactory constructional and activation details. This tube is shown in Fig. la. Figs. lb and lc are two somewhat smaller tubes which have also been investigated but which though usable have not proved as satisfactory. However, work
is to be continued on the problem of still further reducing the image tube size.

Some work has been done on high voltage image tubes and successful tubes have been made to operate at 15KV. High voltage small image tubes have not yet been investigated.

The problem of necessary infra-red sensitivity has been given considerable attention. Information as to the activation methods used by E.M.I. for their tubes, which appear to have about three times the sensitivity of the average tube described above, has been obtained and tested as far as the information permits. Special test tubes made by our regular process and by the E.M.I. method have given up to 2.5 times the normal sensitivity, and one image tube was made having this response. (This tube later developed an air leak.) This work is being actively continued.

III. Driving Equipment

Rather extensive driving tests have been made with the binocular telescope (non-sterio) and lighting equipment shown in Fig. 2. Subject to the limitations of a 30° viewing angle and lack of mobility of lights and telescope, fairly satisfactory results were obtained.

In order to increase the mobility and flexibility of the driving telescope, a helmet type monocular telescope was designed. This type of telescope is illustrated in Fig. 3. Two sets of these helmet telescopes were built. Driving tests showed this type of equipment to be perfectly feasible, although somewhat more fatiguing than driving with the binocular telescope. Certain alterations which would improve the performance of the helmet equipment became apparent in these tests and are being made.

A project is being undertaken on the night driving of tanks by means
of infra-red. The helmet equipment described in the preceding paragraph was built primarily for tank driving, but has a much wider range of application.

In addition to the helmets, infra-red telescopes have been incorporated in protectoscopes for use in tanks with their armor closed. Fig. 4 illustrates an infra-red and protectoscope.

Preliminary driving trials with the Station Wagon show these protectoscopes to be quite satisfactory. Tests were made with the equipment installed in a tank but using the Station Wagon's lights. In spite of the handicap of the lights being on a separate vehicle, this test was fairly successful. A second test with a tank was attempted but was unsuccessful due to the fact that wiring carrying eighty amperes, sixty cycle alternating current, passed close to the image tubes, making it impossible to obtain a good image. A direct current system is now being installed in the tank.

Driving equipment is also being designed for two special vehicles. One of these is a truck equipped with infra-red spotting instruments and various other blackout apparatus, as well as with infra-red driving telescopes. The second is a special purpose military vehicle known as the "Weasel."

IV. Spotting Devices

Infra-red telescopes of various types can be used for other purposes than night driving. Therefore, a number of telescopes primarily designed to have a high sensitivity are being investigated. Some of the purposes for which these are to be used are the following:

1. Observing objects lighted with an infra-red searchlight
2. Detecting infra-red sources
3. Receiving infra-red signal
4. Camouflage studies
A hand telescope with interchangeable lenses of various speeds (f/2, f/1.5 and f/0.95) has been built. This is illustrated in Fig. 5.

Two telescopes employing Schmidt optical systems are now in the process of construction. One of these, having a wide viewing angle and an effective aperture between f/0.7 and f/0.8 is nearly complete. The second which is being built at Mount Wilson under the direction of Dr. O'Brien will have a narrower viewing angle and a speed of about f/0.6.

V. Lighting Equipment

In connection with driving tests a good deal of work has been done on the matter of lighting. Incandescent lights with appropriate filters have been found to be the most satisfactory source of infra-red.

The Station Wagon ordinarily uses two 1000 watt and one 500 watt 12° - 14° #251 heat transmitting glass. So far these lights have proved the more satisfactory of any of those used for driving.

Two 600 watt (P.A.R. 64) sealed-beam lights have been equipped with infra-red filters for driving. A good deal of work was required to develop suitable filters. The most satisfactory filter consisted of an inner layer of signal red pyrex, two layers of 3mm #254 heat transmitting glass and an outer layer of pyrex. These filters require no special provision for cooling.

The sealed-beam lights were tested in various positions on the Station Wagon. It was found that between two, three and six feet above the ground most satisfactory results were obtained with the three feet position. These results were not, however, as good as those obtained with a single 1000 watt spot-light on the roof of the car. Light distribution appeared to be the governing factor.

Some experiments were carried out at Cleveland on the distance at which objects illuminated with a searchlight could be seen with an infra-red
telescope. With a 2500 watt searchlight using a 24" reflector objects could be seen at 200 yards with a telescope having an f/2.7 objective. The data obtained from these observations have been used as the basis of the design of the Schmidt telescope and searchlights to be used on the special infra-red truck.