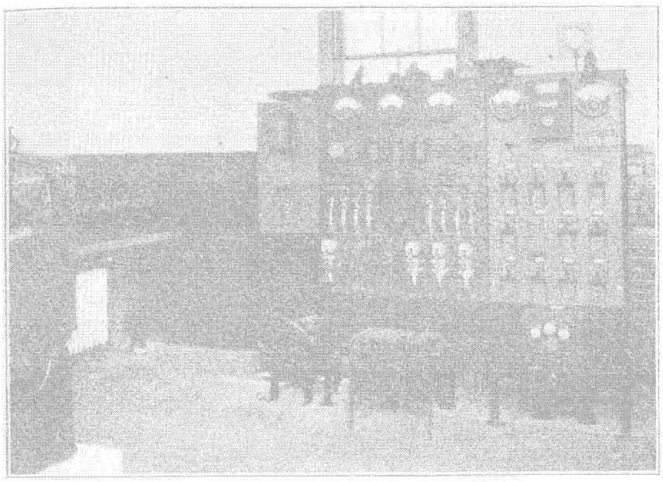
crank the engine, allow the set to come up to full speed and be operating smoothly, ready to assume the load. When the normal supply is resumed the emergency set is automatically stopped and the load



15 K. V. A. Switchboard Installed at Camden, N. J., on the Central R. R. of New Jersey

is instantly transferred back to the normal supply busses by the automatic throw-over switch.

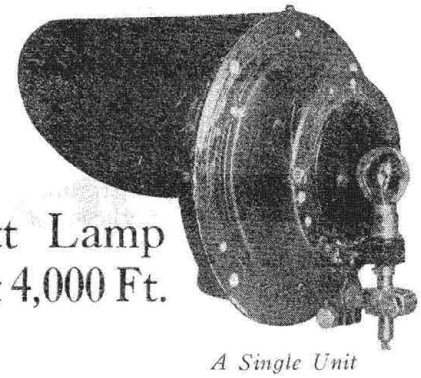
The 35 K.V.A. emergency set on the Reading at Harrisburg is given an actual commercial power failure test at full load every morning to be certain that the system is functioning properly. In making these daily tests, as well as the set operating as an emergency unit, 150 gal. of gasoline at a cost of $21 and 5 gal. of oil at a cost of $4 are used per year, with a labor cost of $20 per year for carbon cleaning, the change of crank case oil and for the usual periodic changing of water in the radiator to prevent rust coagulation.

On the Pennsylvania Railroad a 6 K.V.A. automatic gas-electric Matthews system was installed to serve as a stand-by power supply for an a.c. signal installation extending through an interlocking and a tunnel at Gould, Ohio. As the normal a.c. supply was taken from a transmission line serving mining properties principally, the service was not considered as sufficiently reliable as the power was sometimes cut off for a short time, especially on Sundays, to repair the line. Therefore, the automatic set was installed as an emergency supply and has served quite satisfactorily. This set will pick up the signal load in about 20 sec. from a cold start, and if the engine is warm 10 or 12 sec. only are required. On a service test run this set delivered 16 amp. at 115 volts, about half the rated capacity for a total of 312 hours, or 28 days, operating alternate days, with the exception of the last 72 hours which represented a continuous run.

A 6 K.V.A. set at Warren, Ohio, on this road was tested at three different times for a continuous three-day period of operation, the load being 28 amp. at 115 volts. Satisfactory results were reported. A third set of 10 K.V.A. has recently been installed on this road.

A New Development in Chromatic Light Signals

Ground Glass Lens With Five-Watt Lamp Gives Color-Light Signal Indication at 4,000 Ft.



A Single Unit

By D. J. McCarthy

Chief Engineer, Chicago Railway Signal & Supply Company, Chicago

THE railway signal of the future is going to be a light signal. The semaphore has proved to be, and is still a good signal, but it must give way to a signal which has the characteristics of giving a universal indication for both day and night, without the use of moving parts within itself.

It is approximately 14 years since a light signal first replaced a semaphore. During this time, the light signal has undergone a steady development, but the greatest retardation to its adoption has been the large amount of electrical energy required for its operation and its limited range of visibility. The energy has slowly been reduced from 50 watts for a range of 1,000 ft. to 24 watts for a range of 2,500 ft. This was the condition about eight years ago when the Chicago Railway Signal & Supply Company decided to enter into the development of a light signal, which could compete with the semaphore in energy and indicational range.

These developments resulted in the production of the Chicago Double-Light-Unit giving a 4,000-ft. indication with 10 watts. The optical equipment of this unit was a doublet with lenses of the pressed fresnal type. Although this unit has given satisfactory service for the past three years, it was evident it was not the ultimate in economy, where primary batteries only could be employed. Further developments indicated that higher efficiency could be obtained only by the use of other than pressed fresnal lenses.

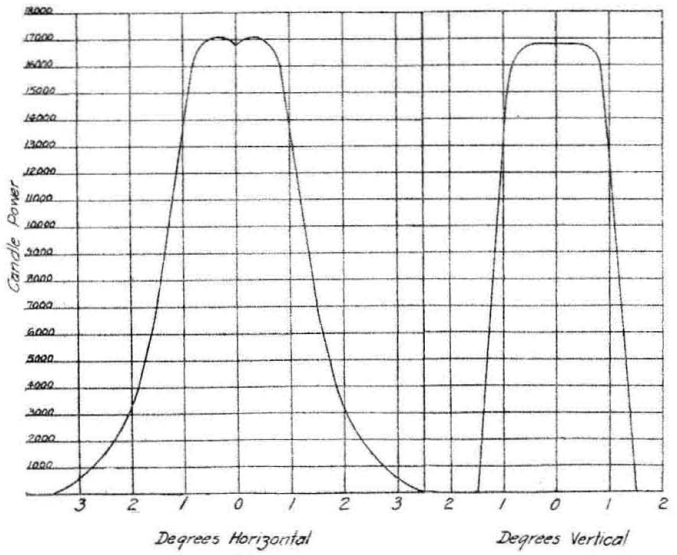
Development Depends on Three Branches of Science

The development of the light signal depends upon three main factors; the light source, the projecting optical element, and the color filters. As each of the elements demanded the study of an optical specialist in that particular field it was recognized by the engineers of the company, that only by enlisting the service of these men could real progress be made.

Therefore, the problems peculiar to the light requirements of the signal as well as their suggested solutions were submitted to such physicists as Dr. Jacobsen of Yale, formerly of the University of Chicago. These researches were made with the assistance of Dr. Jacobsen in the Gaertner Scientific Laboratories

of Chicago. At that time, Dr. Jacobsen was associated with Albert A. Michelson, the noted scientist.

Valuable assistance was rendered by the laboratories of the Eastman Kodak Company in the solution of the color filter problems. These laboratories are leaders in this field being the producers of the Wratten light filters for photographic use. The lens problem was likewise submitted to the leading lens designers, both domestic and foreign. This research and development work has resulted in the production of the Chicago Chromatic Light Signal Unit, which with a 5-watt lamp gives as good an indication at 4,000 ft. as the Chicago doublet unit with a 10-watt lamp.



Curves of Horizontal and Vertical Distribution of Light in the Projected Beam

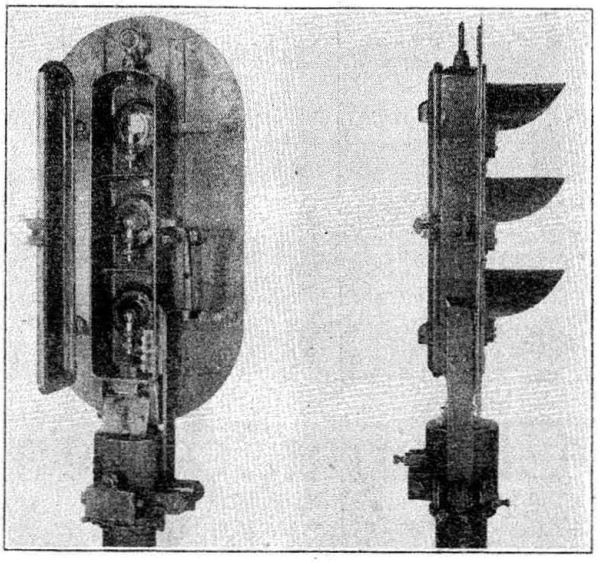
With the proper 10-watt lamp, an equivalent indication is given at 7,000 ft.

The lenses of this combination are not of the fresnal pressed type, but are ground and polished from a special grade of clear glass. The lenses differ from the ordinary projecting lenses, in that their surfaces are not spherical but are compound curves. These lenses have so far been produced by the Bausch & Lomb Optical Company. Developments show that better results can be obtained, by not employing color glass in the lenses. Therefore, color is obtained by the use of specially made filters or roundels, which are spectroscopy correct in relation to the light source used.

The Light Source a Special Problem

The light source or lamp presented as large a problem as the lenses. Its development has been accomplished in the laboratories of the Chicago Miniature Lamp Works. The lamp is so designed as to give the maximum field of illumination in both the vertical and horizontal planes. Although considerable time and expense were consumed in its development, it can now be produced at no higher price than other minute optical lamps. These lamps do not need to be based accurately as they can be accurately brought to the focal point by a focusing device, which is a part of the lens housing. Focusing is done by intercepting a light ray after passing through the first lens. This ray is reflected on a screen, the position of which indicates the focal point. If desired, an accurately based lamp can be employed. Such a lamp can be applied any time after the signal is placed in service for the reason that the position of the adjustable socket can be checked by the focusing finder.

The accompanying curves show the horizontal and vertical distribution of light in the projected beam. The most important factor in determining this distribution is the shape of the lamp filament. It has been the practice in some light signals, so far designed to endeavor to produce a beam having a large horizontal and a narrow vertical spread. In the present signal, this practice has not been adhered to, for the reason that higher efficiency is obtained, if the lenses are uniformly illuminated over their whole surface. Therefore, the lamp filament has been designed to give as close as possible, a beam, in which the vertical spread is practically the same as the horizontal. This results in an intense penetrating beam of light with sufficient spread for easy observation on tangent track. Where a greater spread is required, it can be obtained by the spreadlite roundels. It has been found that higher efficiency is obtained in not trying to produce the spread within the beam; but to make it as concentrated or parallel as possible and then produce the necessary spread by the use of roundels, which can be so designed to spread the light in just the shape



The Entire Signal Head Can Be Rotated or Inclined

or direction required. An advantage in having a vertical spread is that a more even illumination is maintained throughout the range of the signal instead of a bright spot in one narrow region of its range.

As this signal consumes only five watts of electrical energy, the economy effected by its use in any signal system is apparent. The necessary required energy to give an indication is produced at less expense than that for the light of an oil lighted semaphore signal.

In a single track automatic block signal system, averaging 50 motor-driven electrically-lighted semaphore signals with 45 train movements per day, about 18.7 primary cell renewals are required per year, per signal. While with the 5-watt light signal in the same system, approximately 14.2 cells would be required, per year, per signal, an annual saving of 4.5 renewals.

The Interstate Commerce Commission has granted extensions of time for fulfillment of the second train control order of January 14, 1924, from February 1, 1926, to July 18, 1926, with respect to the **Norfolk & Western** and the **Lehigh Valley.** A similar extension of time for fulfillment of the second train control order has been granted to the **Chicago, Burlington & Quincy,** and in addition this road may install an automatic train stop or train control device upon that portion of its line between Pacific Jct., Iowa, and Lincoln, Neb., instead of in the territory specified in the second order.