Electric Switch Lamps on the Santa Fe

Ten years' experience shows advantages of battery operation with approach control

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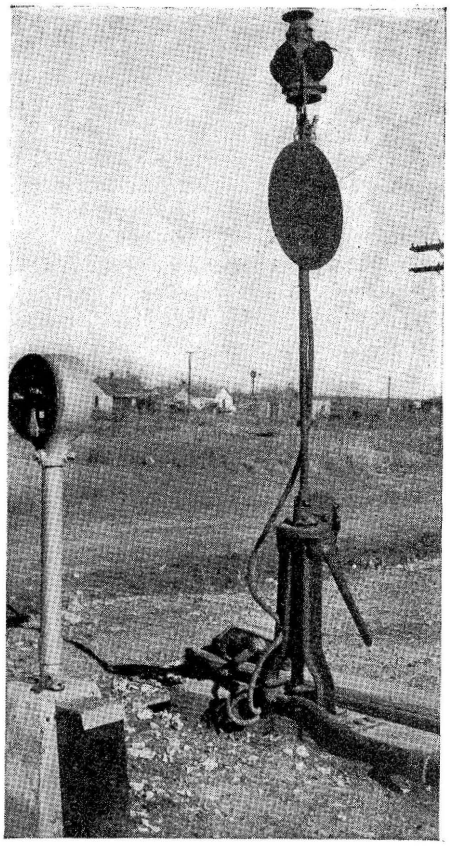


Switch lamp equipped for electric lighting —Indicator shown with cover removed

On the Atchison, Topeka & Santa Fe, switch lamps have been lighted electrically for many years in districts where a-c. power distribution lines are used for supplying energy for automatic block signal operation. Furthermore, during the past decade, the practicability of lighting switch lamps from primary battery has been demonstrated on extended sections of this road where no a-c. distribution lines are used. The success of battery operation is largely due to two factors; the use of the approach-lighting scheme; and the inherent reliability of an electric light fed by an individual energy supply, the latter in comparison with the usual method of oil and wick operation.

Straight A-C. Used Where Available

In general, the switch lamps at power switches and at the majority of the interlocking switches on the Santa Fe are electrically lighted from an a-c. source because an a-c. line is usually available at such locations. The 175-mile automatic train-control territory between Pequot, Ill., and Ft. Madison, Iowa, is equipped for straight a-c. operation, including the switch lamps. Two other sections, between Arcadia, Cal., and Winslow, Ariz., and between Chambers, Ariz., and Dalies, N. M., approximately 585 and 179 miles, respectively, are equipped for continuous a-c. lighting of the switch lamps, the a-c. energy being of low cost. In these districts, however, the switch lamps in yards and side tracks are more often oil lamps, because these can be maintained easily by the track forces.

Battery Operation With Approach Control

Besides the shorter stretches of primary battery automatic signaling on the Southern Kansas and Oklahoma divisions, where a number of electric switch lights are in service, the largest installation of this kind on the Santa Fe lies between La Junta, Colo., to Dodge City, Kan., a distance of 202 miles. In 1929, this single-track territory was equipped with automatic semaphore signaling operated by primary battery. At the same time, some 150 main-line oil switch lamps were converted for electric lighting, using approach control and a separate four-cell battery for each lamp.

The standard oil switch lamp, furnished by the Adams & Westlake Company for the Santa Fe, is equipped with four roundels, the two corresponding to main-line alinement being green, and the two for the diverging alinement being red. The oil fount, for the wick and chimney arrangement, is either one of two sizes, for four or seven days' burning. At most of the outlying switches, such as at blind sidings, the seven-day fount is used in order to reduce the frequency of servicing. In converting an oil lamp to electrical operation, the oil fount is displaced by a Type CLB-325 Oliver Electric classification lamp adapter, which is mounted in the same position without alteration. This adapter accommodates a standard S-11 bayonet-base single-contact lamp.

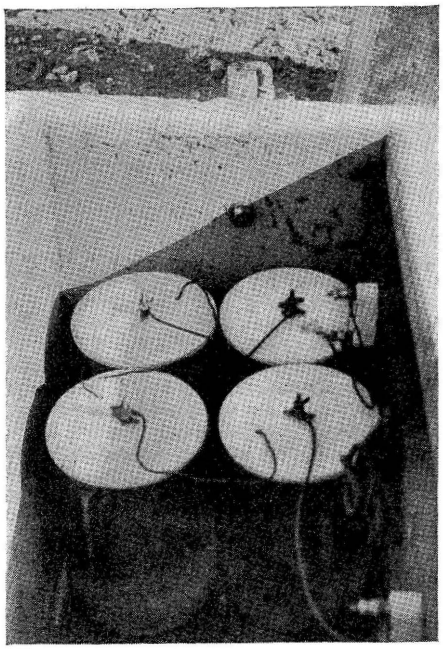
The accompanying illustrations show the method of fitting the switch stand with the two-conductor parkway cable, conduit fittings, and the necessary clamps. As the lamp chimney and ventilator are no longer required, the upper opening is closed by removing the chimney and soldering a thin copper disk in its place. The inside surfaces are then painted aluminum to reflect as much light as possible. In some instances, especially

in the dust-ridden territories of Western Kansas, the adapter is sealed at the bottom of the lamp with compound in order to exclude the dirt. Lamp renewals, which are seldom required, are made in such cases by removing a roundel.

In order to obtain a good indication with a low-wattage lamp, the adapter may need to be adjusted slightly to insure proper placement of the filament with respect to the roundels. One maintainer has devised an ingenious method for accurately placing the lamp adapter. By means of two disks arranged with peepholes and cross-hairs, temporarily substituted for two opposite roundels, the filament can be readily placed at the central point, and the adapter firmly fastened. A copper sighting tube is sometimes mounted in the upper portion of the lamp to facilitate alinement with the track.

Life of Battery

As previously indicated, unless a lamp of very low wattage is used, the economic success of primary battery operation depends upon means of controlling the light circuit upon the ap-



Four cell battery is used to feed switch lamp

proach of trains, so as to conserve the battery. If lighted continuously, the standard 3.5-volt, 0.3-amp. lamp would exhaust a 500-a.h. battery in 1,660 hr., or about 70 days. The 3.5-volt, 0.120-amp. lamp more recently adopted for certain locations would exhaust the battery in 4,167 hr., or 173 days. Records obtained over one maintainer's territory indicate that approach-lighted installations, using the 0.3-amp. lamp, require renewal of the 500-a.h. primary battery after approximately 280 days' service in a yard area, depending on traffic volume. On the other hand, at a blind siding, one battery gave 1,330 days, or almost four years of service before renewal. In other words, it has been renewed but once to date since it was first installed in 1929. Another battery lasted 1,015 days after first being set up, but was recently renewed after the second cycle, which was of 1,685 days' duration, both covering a total of nearly eight years since the original signaling was placed in service, in 1929. Other locations commonly show battery life of 500, 650, or 1,000 days. The average of 73 renewals divided among 19 batteries in this territory is 530 days. Computed on the basis of this average figure and assuming the renewal cost as $1.25 per cell or $5 per battery, the energy cost appears to be approximately $3.44 per year.

Approach-Lighting Circuits

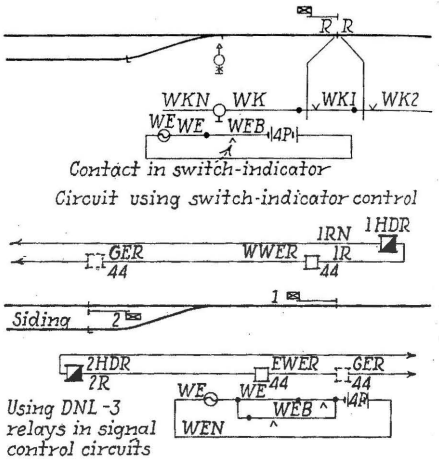
The accompanying circuit plan illustrates two methods of approach lighting the lamps. One utilizes a back contact operated by the switch indicator mechanism which, in turn, is de-energized by approaching trains in either direction, as illustrated. The other method is used at passing siding switches, where no switch indicator is available but where the signal controls are within easy reach. In such cases, a 44-ohm DNL-3 series lighting relay is inserted in each of the two adjacent signal circuits. Either of these, when de-energized by a train from either direction, closes the light circuit by means of a back contact. Where a switch is situated near a signal location, the four-cell switch-lamp battery is housed in the signal cellar; otherwise, a separate concrete box is used at each switch.

Electric Vs. Oil Lighting

It must not be concluded that electrical operation of switch lights is universally applicable, from an economic standpoint, without careful consideration of all the factors. Of course, a primary battery may be installed almost anywhere, as adaptability is one of its inherent qualities. However, the means of approach control, housings, etc., might involve expense too great to be justifiable. Some of the points to be considered, as well as representative costs, are presented in the following paragraphs, which have been developed from the experience of the Santa Fe.

An oil lamp may be installed on a switch stand for about $9. The cost of operation and maintenance has been the subject of considerable investigation. As most of the Santa Fe switch lamps are equipped with four-day founts, they must be refilled twice each week. Others equipped with large seven-day founts require filling only once each week. Where several lamps are located close together, as in yard, they can be maintained at a lower cost than the same number of lamps scattered over a longer territory, as on the main line. Investigation seems to develop costs of $12 to $18 per year for maintenance of oil lamps with four-day founts, and $10 to $12 for lamps with seven-day founts, although this cost has been estimated to be as high as $2.50 per month, or $30 per year. An average annual cost of $12 is undoubtedly a very conservative figure for comparison purposes.

By electrically lighting the switch



Typical approach-control circuits for lighting switch lamps

lamps, a stronger light and greater reliability can be obtained. Strong winds may extinguish the flame of an oil lamp, and the lamp must be cleaned and refilled at least once each week, and inspected frequently in order to avoid failures. In comparison, an electric lamp requires only very little maintenance, and is subject to only an occasional failure such as are encountered with automatic block signals.

The cost of installing and operating electric lights varies considerably, depending upon the kind of current available, the length of cable or wiring which must be installed to connect the source of power and, where approach lighting is used, the method of control and the density of traffic at the particular location where the lamp is installed. The installation cost also varies considerably according to the actual method of installation. If elec-

		Cost of Installation	Annual Maintenance and Operation
(1)	Continuous lighting—a-c.	$35	$ 7.70
(2)	Continuous lighting—d-c.	45	15.50 to $30.50
(3)	Sun relay—d-c.	85	16.50
(4)	Approach lighting on d-c. with switch indicator (new work)	48	9.00
(5)	Approach lighting on d-c. with switch indicator (old installations)	66	10.50
(6)	Approach lighting on d-c. without switch indicator	75	13.00

Note: Operation costs presume use of the 3.5-volt, 0.3-amp. lamp when batteries are used.

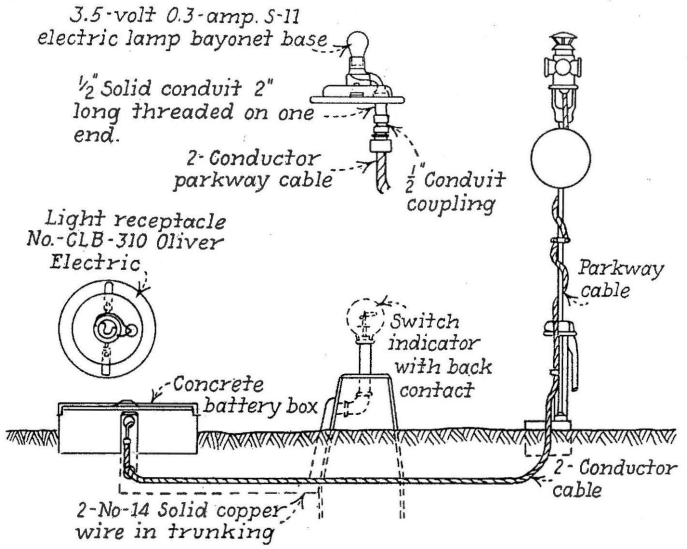
tric lights are installed at the same time as the automatic block signals, labor costs will be reduced because all necessary facilities are available to handle the work in the most efficient way. The following figures may be considered as an average cost when electric lights are added after the automatic block signals have been placed in service, a small construction gang being used for the installation. If the work is done during the construction of automatic block signals, the cost of installation may be reduced by about $8 below the figures given in the table.

Thus, it appears that each contemplated installation must be considered on its merits, because the actual cost varies with local conditions and the methods of installation which must be used. Where alternating current is available, the most economical arrangement is to provide continuous lighting. Where a source of central power is not available, batteries must be used. If the lamps are continuously lighted, this will run into considerable cost unless the smaller type of electric lamp is used, as mentioned in connection with certain favorable installations. This lamp is so small in wattage that accurate focus has to be provided and it is rather difficult to obtain a good light. It may, however, be operated continuously at a cost of about $15.50 per switch per year, while the 3.5-volt, 0.3-amp. lamp would cost about $30.50 per switch per year if lighted continuously on primary battery.

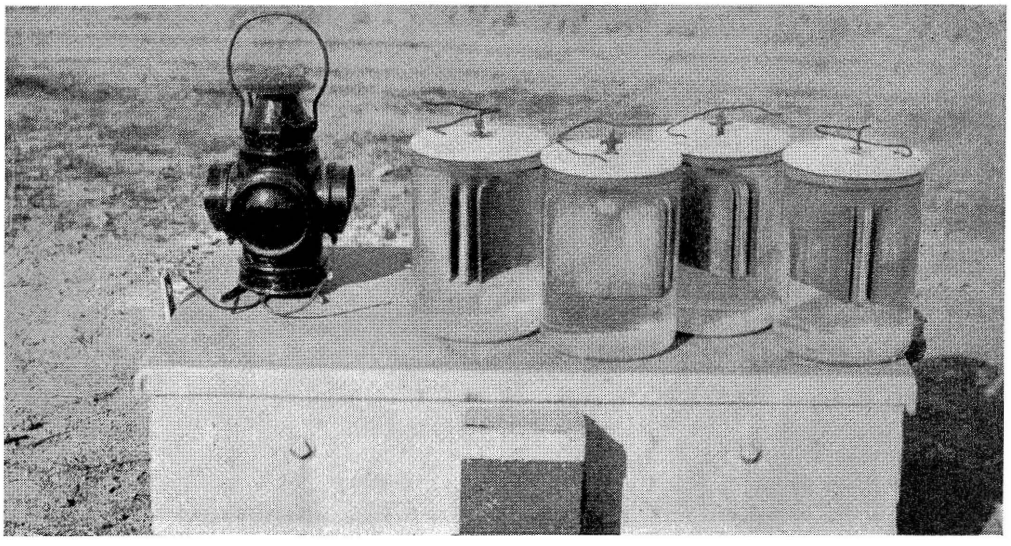
Of course, a sun relay, which extinguishes the light automatically during daylight hours, could be used to reduce the operating cost to about $16.50 per switch per year with the higher-wattage lamp. However, the installation cost would then be approximately $85, which appears excessive. Neither of these arrangements can be considered economical when it is possible to install approach lighting, as has been described for the installation of automatic signals between Dodge City and La Junta.

All of the figures given for the cost of installation of electric lights are based upon using the existing oil lamp with an adapter socket applied for electric lighting in place of the oil fount. The maintenance and operation costs include interest on the original investment.

The Santa Fe has experienced no difficulty with the La Junta-Dodge City installation of electric switch lamps. On the contrary, the indications obtained from these lamps are generally better than those obtainable from oil lamps. As the present practice is to allow the bulbs to operate until the filaments break due to vibration or natural exhaustion, an electric switch lamp need not be opened for long periods of time. As the lamp filaments often last for two years or more, as do the batteries, failures in service are indeed few.



Construction details for equipping switch lamp for electric lighting



This battery renewed after 300 days service in the yards. The switch lamp has been overhauled for electric lighting.