other observers may have been more fortunate. Most flashes show a much larger number of discharges, as is illustrated by Figures 3 and 4. Figure 3 is a record of the same flash taken by the revolving camera. The sequence of the discharge shown in this photograph occurred from left to right and the number of discharges are approximately 36. The time intervals between discharges are very irregular, although the average time between them at the beginning of the discharge is longer than that of the finish. There is also a very marked difference in the magnitude of the several discharges and what seems very peculiar is that the first two discharges are very faint in comparison with the third, which appears to be the main one. This is also a rare occurrence, as in most flashes the first discharge stands out clear and strong. The duration of this flash was 0.55 of a second and the estimated length of what is shown upon the plate is 0.76 of a mile.

In all, the most striking record that it has been the good fortune of the writer to secure is shown in Figure 5, which was made by the stationary camera, while Figure 6 was the one made by the revolving camera. Both pictures show the same flash. These were secured during one of the first electrical storms of the season which occurred during the early part of April. The weather was quite cold and this particular storm broke shortly after midnight and continued until the early hours of the morning. The flashes were extremely clear and vivid, following each other at approximately three minute intervals. The one shown here occurred at four o'clock in the morning, the thermometer registered a temperature of 42 deg. No rain was falling at the time nor had there been for two hours previous. The wind was blowing approximately 35 miles per hour. At least 44 discharges can be counted in this flash. The estimated time of duration is 0.71 of a second. Assuming that the flash occurred over a plane equal in distance from the camera, its estimated length is 2.56 miles. It is very probable that such a flash is irregular along the axis of the camera as well as right angles to it, which would make the actual length of the discharge much longer than that stated above. The thunder from this flash persisted for an interval of seven seconds and was very irregular in volume.

### The Knowledge Gained from Photographs

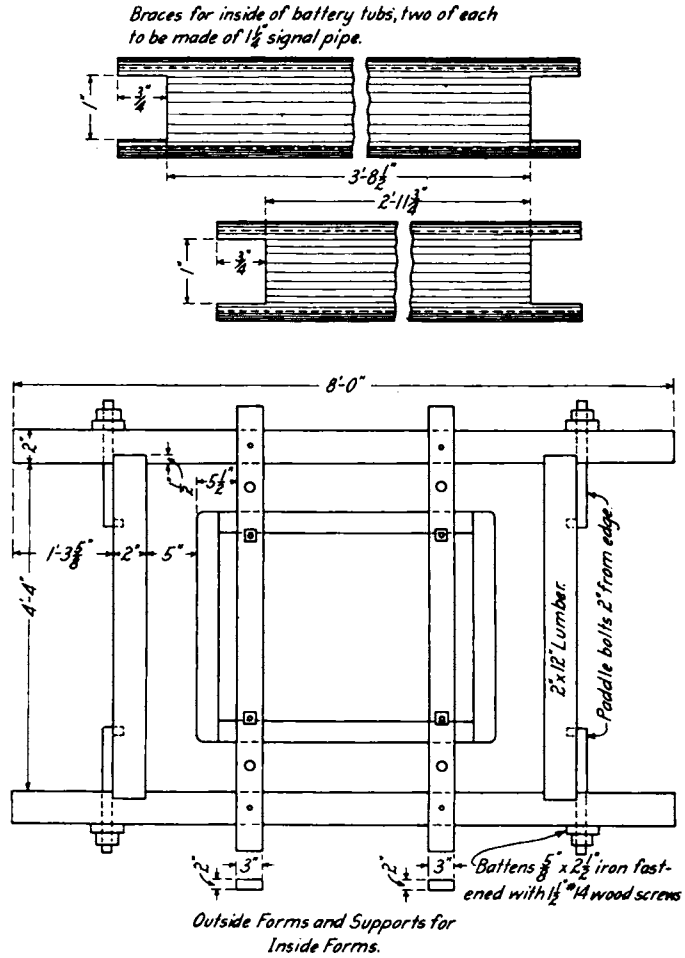
From such photographs some knowledge of the rolling of the thunder may be obtained. These individual discharges no doubt must have some bearing upon the phenomenon. These records show that the duration of the lightning flash is considerably longer than what it is popularly supposed to be, but that the individual discharges going to make it up are extremely short.

We can also gain some knowledge of the enormous amount of energy expended in these lightning flashes. Where voltages of such value are generated as to cause a flow of current over an air gap of two or three miles, wires having a capacity sufficient to require a current of 200 amperes to fuse them have been vaporized for a distance of several feet by such discharges. This amount of current with the voltage necessary to send it over such an air gap has an energy value in k.w.'s that is hard to realize. This illustrates the problem the electrical engineer has to solve before his apparatus is immune from the dangers of the lightning discharge; also the absurdity and presumption on his part to attribute the name "Lightning Arrester" to his protective apparatus. When the lightning once starts on its journey from the clouds to the earth, it will reach the earth regardless of man's greatest efforts to arrest it. He may to some extent divert it from the path it would naturally follow, but he can never stop or arrest it.

# COLLAPSIBLE FORMS FOR CONCRETE TUBS

By Walter E. Gemmill
Signal Foreman, Pennsylvania Railroad, York, Pa.

CONCRETE battery tubs can be successfully constructed in the field if suitable forms are used into which the concrete can be poured and properly tamped. These forms, however, must be strong enough to withstand ordinary rough usage and at the same time they must not be too heavy or else the burden of handling them becomes a tedious job. They must also be constructed in such a manner that they can be readily removed again after the concrete has properly set. Concrete tubs designed to hold 54-500-ampere-hour caustic soda cells have been constructed at signal locations on




**The Assembly of Inside and Outside Forms Showing Braces**

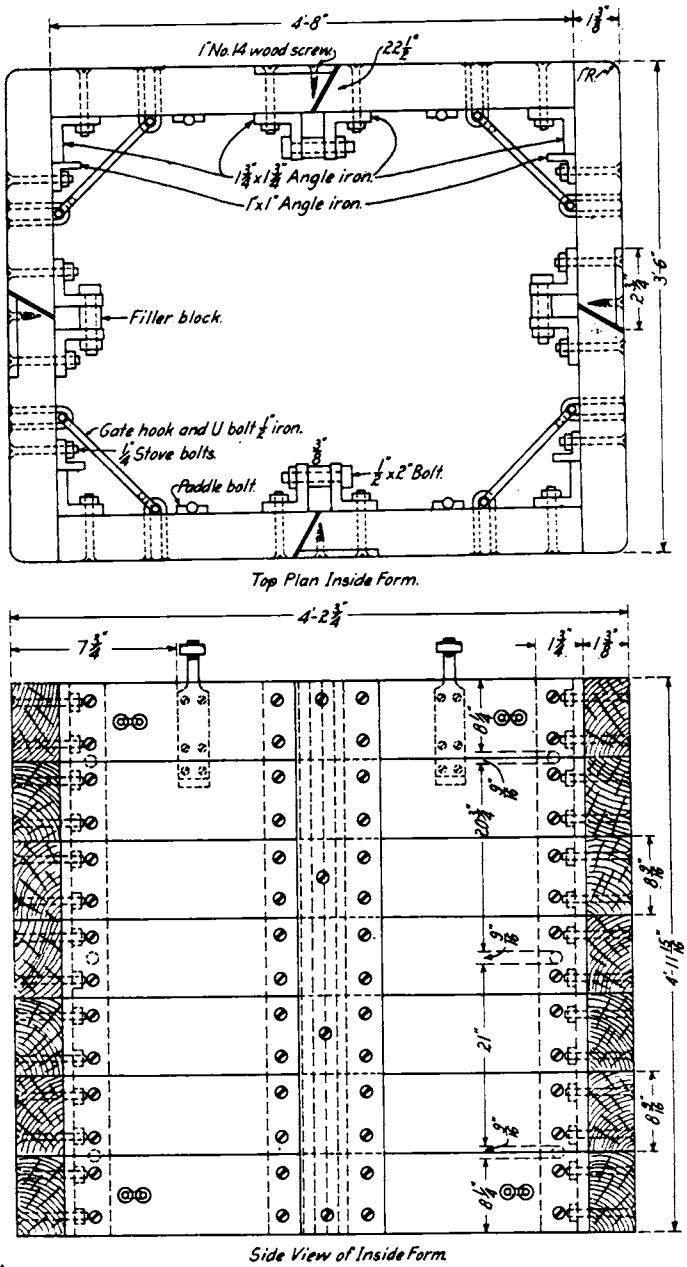
one of the large roads, by means of the collapsible forms described here.

The forms required for constructing a battery tub consists of two parts, namely, the outside form and the inside form. The former is made up of four pieces of 2-in. by 12-in. lumber, two of which are 8 ft. long and two pieces 5 ft. 9¾ in. long. The two shorter pieces are framed to fit into two channels or notches ½ in. deep cut into the two larger pieces as shown in one of the illustrations. The four parts forming the outside are held together by four paddle bolts with nuts and washers.

The inside form which is shown in another illustration consists of two sides and two ends built from a good grade of white cedar 1⅜ in. thick by 8 9/16 in. wide. Each side and end is made in two sections. These sections are held together at the mitre joints by means of

Digitized by Google

angle iron strips 5 ft. long, one on each section, bolted together. The points on the outside edges of the mitre joints are protected by 5 ft. strips of ⅛-in. by 2¾-in. iron. Five-ft. pieces of 1¾-in. by 1¾-in. angle iron are fastened on the inside surface along the outside edge of the side pieces. These pieces of angle iron butt against the outside face of 5-ft. pieces of 1-in. by 1-in. angle iron, which are fastened to the end sections of the form as shown in the illustration. All angle iron pieces are fastened to the woodwork by means of stove bolts as shown.

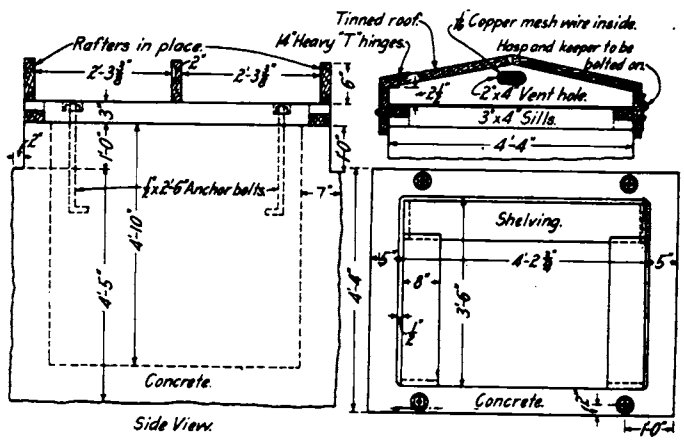



**Drawing of the Inside Form**

In order to hold the forms together at the corners, gate hooks and "U" bolts are provided.

In using this collapsible form for constructing concrete battery tubs, a hole should be dug five inches larger on all sides measured from the outside surface of the inside form and five inches below the bottom of the form. After the hole has been dug, the outside form should be set in place and leveled up. The inside form can then be placed. First, the side pieces containing the paddle bolts should be hung from two iron supports which should be placed across the top of the outside form. The end pieces can then be fastened in place by means of the gate hooks. Then the four pieces of 1¼-in. signal pipe should be placed between the sides and ends with the ends of the braces resting on the ½-in. bolts in the angle iron pieces next to the mitre joints. Four anchor bolts ½-in. by 26-in. should next be hung in the hole provided in the bars which supports the side forms. These anchor bolts are required for holding the sills for the frame work of the cover to the tub. After the collapsible forms have been properly set and the bolts have been tightened up and the corners locked in place, the work of placing the concrete can be started. The bottom part of the tub should be filled in with dry concrete up to the bottom of the form. This should be well tamped, and then wet concrete, thoroughly mixed, can be filled in between the inside form and the earth side of the hole which, as stated above, should not be less than five inches from the outside surface of the inside form. It must be understood that the sides of the hole serves the purpose of an outside form up to a point 12 in. from the top, at which point the outside form described above serves the purpose of providing a neater finish to the work at the top of the tub.

After the concrete has become hard enough the inside form can be taken out. This can be accomplished by removing the filler blocks between the angle iron adjacent to the miter joints. Gate hooks should be unhooked, and if a small pinch bar is applied to any right hand section of the inside form it will start the loosening process. After one section has been removed it will be an easy matter




**Details of the Cover and Shelving**

to remove the remaining sections. When the inside sections have been removed the outside form can be taken apart in a similar manner. Then a finishing concrete mixer should be applied to the exposed surfaces of the tub. The inside bottom of the tub should be smoothed off with concrete about two inches thick. In order to do this, however, a hanging scaffold may be necessary.

The next step in the procedure of completing the concrete battery tub is to provide battery shelves and a cover. The battery shelves can be arranged to suit conditions. however; one scheme is shown in one of the illustrations. In this case ⅞-in. by 8-in. lumber has been used. Three shelves are provided on each of the three sides of the tub. The center shelf is set out from the wall ½ in. to provide room for wires. It will be noted that there is a one-inch space around the top edge of the tub upon which a frost board can be placed if required.

The covering for the top of the tub is built up on the sills which are made of 3-in. by 4-in. lumber, cut to the proper length and framed as shown in the illustration. The side sills are held in place by means of two anchor bolts. These in turn hold the end sills, which are framed in such a manner as to permit the ends of the side sills

Digitized by Google

to match into the end sills. After the sills are in place a finishing board ⅞ in. by 3 in. is fastened around the sills with the top edge one inch below the top of the sills. The next step is to add the rafters, which consist of two ends and a middle section. When these are placed in position finishing boards should be nailed around the end and sides, allowing them to extend one inch below the bottom of the rafters into a rabbit formed by the previously mentioned finishing board fastened around the sills. The next step is to place the boards forming the roof, to which a tin covering can be added, allowing the tin to extend down over the sides and ends about 1½ in. Two 14-in. heavy "T" hinges should then be fastened on one side of the cover and sill with a hinge hasp and keeper fastened to the opposite side. To prevent the cover from opening too far, a piece of ¼-in. signal chain can be fastened to the inside of the cover and sill at one end of the tub. In order to provide sufficient ventilation it is well to cut a hole in each of the end rafters, covering it with 1/16-in. copper mesh, as shown in the illustration.

# What Is to Be the Future of the Railroads?

*Some of the Plans Suggested by Associations and Individuals as a Means of Solving This Problem*

THE solution of the railroad problem is of vital interest not only to the general public but to all railway men. A brief abstract of some of the plans offered to the Senate Committee on Interstate Commerce at its recent meetings are given below for the information of signalmen.

### The Railroads' Plan

The plan evolved by the Association of Railway Executives, representing about 92 per cent of the railway earnings of the country, provides that Congress make it possible for the carriers to give the public the advantages of conservation of capital by requiring unification of lines and terminals, when required in the public interest, by promoting useful consolidations, and permitting agreements as to rates and practices, the benefits of which have been proven during federal operation, but which the carriers by law have been prevented from supplying.

Its fundamental features, to which details of organization and operating machinery are subordinate, are:

(1) The creation of a department of transportation, headed by a secretary, who would sit at the President's council table, who would relieve the Interstate Commerce Commission of its executive duties; and in whose jurisdiction would be centered rate regulation subject to revision by the Interstate Commerce Commission, and the fixing of wages, and who would use the power of the administration to maintain proper service, to create the necessary credit for the carriers, and to maintain harmonious relations between employers and employees.

(2) The adoption of a fixed policy as to the revenues of the carriers by requiring that the influence of the President, through his secretary of transportation, shall be put behind movements for increased rates which he finds proper, and the establishment of a statutory rule for rate-making, which shall require that rates be not only reasonable but adequate and sufficient to protect existing investment and to attract capital necessary to maintain existing properties up to the standard of the public need, and for the construction of extensions and branches.

(3) To provide for compulsory federal incorporation and for the elimination of the conflict of regulating power between the states and the federal government as to all essential matters, including rates, state and interstate, with as little interference as possible with the state commissions in carrying out the intended purposes.

### Railroad Security Owners' Plan

A plan for the return of the railroads to private operation and for their future regulation was presented to the Senate Committee on Interstate Commerce by S. Davies Warfield, president of the National Association of Owners of Railroad Securities. The principal feature of the plan proposes that such rates for freight and passenger service shall be established as will produce a minimum return (6 per cent suggested), excess earnings above this amount to be distributed under the control of the Interstate Commerce Commission, part of it for the benefit of the employees and part of it for improvements. It is also proposed to create a National Railways Association, directed by trustees composed of the nine members of the Interstate Commerce Commission and eight railroad men, to assist in financing the return of the roads and to continue or adopt co-operative methods of operation. The plan also provides a system of regulation by the Interstate Commerce Commission and six regional commissions with a co-ordination of federal and state authority.

### The Interstate Commerce Commission Plan

Much can be said as to the relative advantages and disadvantages which accrue from or necessarily attend either government ownership and operation or private ownership and operation. It seems obvious that no plan of private ownership should be considered unless it be under a broadened, extended and amplified governmental regulation. Considering and weighing as best we can all of the arguments for and against the different plans, we are led to the conviction that with the adoption of appropriate provisions and safeguards for regulation under private ownership it would not be wise or best at the present time to assume government ownership or operation of the railways of the country.

The fundamentals of a proper transportation policy are:

1. The prompt merger, without friction, of all the carriers' lines, facilities and organizations into a continental and unified system in time of stress or emergency.
2. Merger within proper limits of the carriers' lines and facilities in such part and to such extent as may be necessary in the general public interest to meet the reasonable demands of our domestic and foreign commerce.
3. Limitation of railway construction to the necessities and convenience of the government and of the public and assuring construction to the point of these limitations.
4. Development and encouragement of inland waterways and co-ordination of rail and water transportation systems.

In the event of a continuance of the policy of private ownership and operation under governmental regulation, we think that the following matters require regislative consideration.

1. Revision of limitations upon united or co-operative activities among common carriers by rail and by water.

Digitized by Google