

tions which this Engineer-Constructor team which we are developing is sure to face,—is there any detail which the candidate for responsibility can afford to ignore? Is it not better to have an organization of trained men prepared to help each other do these various things, rather than depend upon unsupported individual effort?

Granted that such an organization of technically trained men can be brought together, what are some of the things which they may be called upon to do? A few of the things requiring such ability and experience in design and construction which first occur to us are as follows:—

- Complete Steam Railroads,
- Complete Electric Railways,
- Electrification of Steam Roads,
- Hydro-Electric Plants,
- Transmission Systems,
- Power Plants,
- Gas Works,
- Electric Lighting Systems,
- Industrial Establishments,
- Buildings for all Purposes,
- Public Service Works.

In so far as an organization is prepared to effectively carry out any of these enterprises just that far will it reach its highest development.

To show the possibilities of such an organization, let us pick out a team for the building of some large proposition. Let us take for instance, the design and construction of a steam railroad locomotive repair shop, involving the expenditure of from two to three million dollars.

In deciding on our men, we will make a study of the qualifications of each one, and at the same time we must have a clear conception of the work each one must be familiar with in order that there be no weak spots in our line, or break in the organization. The selection of men with their chief duties will be as follows:—

Industrial Expert:—

- Designing Layout of Shops.
- Planning Method of Handling Work.
- Arrangement of Tool and Transportation Equipment.

Electrical Engineer:—

- Providing Power and Lighting Equipment.
- Laying Out Transmission Systems.
- Planning Telephone and Signal Systems.

Mechanical Engineer:—

- Design of Power Plant.
- Plan of Heating and Ventilating.
- Laying Out Air, Gas and Steam Systems.

Structural Engineer:—

- Building Foundations.
- Designing Steel Structures.
- In Charge of Reinforced Concrete Construction.

Architect:—

- Designing Building Superstructure.
- Choice of Fixtures.
- Laying Out Landscape Work.

Civil Engineer:—

- Directing Grading.
- Testing of Soil.
- Construction of Track.

Sanitary Engineer:—

- Design of Sewage System.
- Construction of Water Works.
- Choice of Plumbing.

Purchasing Agent:—

- Selecting Markets for Material.
- Checking Bills of Material.
- Arranging for Delivery of Material.

Constructing Superintendent:—

- Organization of Construction Force.
- Consideration of Time Element in Construction.
- Settling Labor Difficulties Arising in Connection with Construction Work.

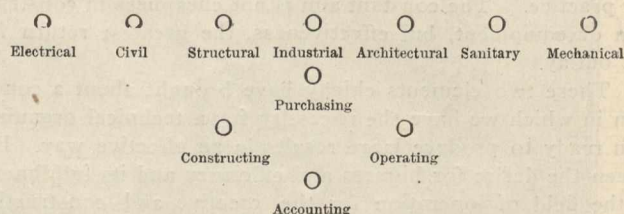
Operating Engineer:—

- Consideration of Economies in Operation.
- Securing Reliability in Operation.
- Insuring Effectiveness in Operation.

Accounting Department:—

- Keeping Pay Rolls.
- Making Record of Costs.
- Preparing Progress Reports.

The line-up of the team may be shown by Fig. 1. Here are eleven men,—each one selected for his particular ability to solve the problems suited to his individual training and experience. Each man has won his position as the result of a gradual growth which has demonstrated his reliability and resourcefulness. Many of these men have played this game before, and together, and are always eager for a proposition which will tax their strength and skill.



**Line Up of The Engineer-Constructor Team
For The Building of a Railroad Repair Shop.**

Fig. 1.

Let us watch the play. First will come a number of preliminary studies, showing the proposed sizes, designs and relative arrangements of the buildings. There will next be forthcoming a carefully prepared report, showing the advantage of the finally selected arrangement, and the suggested construction of each of the buildings, together with a description of the equipment required. An important part of this preliminary report is an approximate estimate of cost, based upon a careful consideration of all the items involved in the construction.

With the general layout and the preliminary report and estimate approved, the next move is to prepare the plans and specifications. To indicate the scope of this work, the following classification is shown, the numbers being the key which is placed in each drawing, specification, data sheet, report, or letter which may be originated as the work progresses.

The entire range of work undertaken by the company, and all incidental construction connected therewith, is grouped under the following general heads and assigned the range of numbers indicated:—

Divisions of Classification.

Division.	General Subject.
—000—	Organization and Engineering.
—100—	Buildings and Building Material.
—200—	Hydraulic Construction and Equipment.
—300—	Bridges and Tunnels.
—400—	Tracks and Roadway.
—500—	Electric Transmission Lines.
—600—	General Equipment.
—700—	Power Plant Equipment.
—800—	Tools and Instruments.
—900—	Transportation Equipment.

Each division above is subdivided so as to cover all possible classes of construction that may arise. Thus, for instance, in the 100 to 200 series it is possible to have one hundred subdivisions each representing a different class of work. Each of these may, of course, again be divided to any extent desired by using decimals. Each piece of work undertaken is given a contract number which is prefixed to the general classification number and thus the identification of any letters, drawings, or data sheets is made easy and certain. As an illustration, suppose the number 109 is assigned to roofing. This number would be used in roofing specifications and contracts in all work done. Its particular application to roofing done under contract 74 would be indicated by the number 74.109. As a further subdivision 109.1 might stand for slate roofing and 109.2 for composition roofing. The number 74.109.1 on a drawing would then indicate its relation to slate roofing for contract 74. To locate the building upon which the roofing is placed a letter is