BLUEPRINT READING AND SKETCHING

FOR

PETROLEUM INDUSTRY WORKERS

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By

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INTRODUCTION

The purpose of this study is to determine the petroleum workers need for blue print reading and to provide suitable instructional material to meet this need. The outline for this work was prepared as a result of conferences with several Officials of Petroleum Refineries. The material to be used in instructing the student was obtained from the engineering departments of the Continental Oil Company, Ponca City, Oklahoma; the Phillips Petroleum Company, Bartlesville, Oklahoma; and the Great Lakes Pipe Line Company, Kansas City, Missouri. The method of presenting this material to the petroleum worker has been evolved by the writer through the teaching of the subject for two years. The material was selected and classed according to difficulty as a result of its actual use in teaching.

The method used in securing data was by making personal calls at engineering offices and selecting suitable material from blue print files and, by conferences with Petroleum Officials at which times the outline was discussed, criticism was solicited and standardized blue prints obtained to substantiate the outline. The method of introducing orthographic projection was taken from a study made by Mr. E. E. Digby, B.S., Genoa, Ohio, which proved that orthographic projection could be taught more thoroughly by making isometric drawings from three view drawings than vica versa.

ACKNOWLEDGMENT

In the preparation and execution of this work, credit should be given the following persons: Mr. Fred Fellows, Superintendent, Ponca City Refinery, Continental Oil Company, Ponca City, Oklahoma; Mr. Frank R. Lake, Chief Draftsman, Continental Oil Company, Ponca City, Oklahoma; Mr. R. E. Richardson, Chief Engineer, Great Lakes Pipe Line Company, Kansas City, Missouri; Mr. Paul Hubbel, Production Department, Phillips Petroleum Company, Bartlesville, Oklahoma; Mr. Fred Heisler, Director School of Technical Training, Oklahoma A. and M. College, Stillwater, Oklahoma; Mr. Henry P. Adams, Assistant Professor of Industrial Arts Education, Oklahoma A. and M. College, Stillwater, Oklahoma; and Mr. H. A. Huntington, Professor of Trade and Industrial Education, Oklahoma A. and M. College, Stillwater, Oklahoma. Credit is also due the many petroleum workers who were students in the night school classes for their cooperation and assistance during the accumulation of the material and the working out of a method of presentation.

COURSE No. G-8

BLUEPRINT READING AND SKETCHING

FOR

PETROLEUM INDUSTRY WORKERS

Vocational Training Courses
Petroleum Industry Series

By

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Ponca City High School

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FOREWORD

This course, Blueprint Reading and Sketching for Petroleum Industry Workers, is the eighth in the General Instructional group of the Vocational Educational Courses, Petroleum Industry Series, as set up and developed by the joint educational committee of the American Petroleum Institute and the Departments of Industrial Education of Texas and Oklahoma. It is the intent of the above named groups that this book be used as a text for the regularly organized evening school classes in the petroleum industry. However, it will be profitable for those who cannot attend evening school classes as a home study course.

The author, Mr. Maston L. Powers, has had a varied experience in the construction work and is a qualified instructor in a high school training that provides trade training in drafting for boys. In addition he has had several years experience teaching blueprint reading and sketching to men from the refineries in evening school classes. Consequently, he is well qualified to produce this text, and seeks your sincere cooperation in its use.

This text was validated for use in the Production Division of the Petroleum Industry at a regular meeting of the topical committee of the American Petroleum Institute, September 16, 1938.

The text, although planned and developed for the petroleum industry, may find a place in other industries as only the blueprints are definitely of this one industry. Too, it may be used in the day industrial schools as organized in the petroleum industry areas.

Suggestions to Instructors:

The first unit of the text is essential and general, and is applicable to all phases of the industry. After this is completed, the membership of the class should determine the units to be used. If they be from the pipe line group, they will be most interested in the pipe line drawings, etc. One or more of the sets of prints may be used as the class may desire, and the duration of the class will be determined by the number of applied units studied.

Instruction should not be limited to the prints supplied in this text but it should be supplemented by practical prints from the industry represented by members of the class. Petroleum companies will gladly cooperate in furnishing other prints of a practical nature.

If a class be composed of men from different departments of the petroleum industry, the instructor may let them choose the prints desired and conduct the class on an individual instruction basis. The course lends itself to individual instruction very readily.

As with all other texts in the Petroleum Industry Series the editor will welcome criticisms and corrections and additional prints that will better carry over and apply this instruction as desired by the committee.

W. Fred Heisler

PREFACE

Modern industry depends upon the language used in blueprints to describe and define the many things to be constructed in order that production can be had and maintained. The importance of this language of blueprints is made evident by the demands of workers for instruction in the subject and the importance of understanding the subject at times of promotion. The material presented in this book is the result of conferences with petroleum engineers and the actual experience of teaching blueprint reading and sketching to petroleum workers in night school class for a period of two years.

The blueprints used in this book are furnished through the courtesy of the Continental Oil Company, The Phillips Petroleum Company, and the Great Lakes Pipe Line Company.

Credit is due Mr. Fred Fellows, Superintendent of the Ponca City Refinery, Continental Oil Company, Ponca City, Oklahoma, for his suggestions and criticisms; Mr. Frank Lake, Chief Draftsman, Continental Oil Company, for his cooperation in providing blueprints and suggestions; Mr. Henry P. Adams, Assistant Professor of Industrial Arts Education, Oklahoma A. and M. College, Stillwater, Oklahoma, and Edwin E. Digby, High School Instructor, Genoa, Ohio, for the use of the first fourteen problems presented in this book, which were worked out at Ohio State University; and Mr. Fred Heisler, Director of the School of Technical Training, Oklahoma A. and M. College, Stillwater, Oklahoma, for his suggestions and assistance throughout the work.

Credit also is due the many petroleum workers who were students in the night school classes and who played an important part in the final choice of blueprints and problems used and for their cooperation in working out questions and in checking the blueprints and questions for errors.

M. L. Powers

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Unit I

SKETCHING AND THE THEORY OF MECHANICAL DRAWING

1. What Blueprints Are:

A blueprint is a copy of a working drawing or mechanical drawing made by engineers and draftsmen in industry. A working drawing shows by means of lines, figures, notes, and dimensions, the information needed by the workman in order to build a certain structure. If the engineering department of an industry were to take the time to write a letter to a man in the field telling him to build a base for a pump at a certain location, giving him the exact location of the bolts, the height of the base, the dimensions of the base, and all other information necessary to complete the job, the letter would be long and complicated. The workman would have to take the time to read the letter several times trying to understand what the engineer meant and trying to get a mental picture of the pump base before he could begin work. Then the workmen would probably make some error in locating the bolts or placing the base in the wrong direction, due to some little mistake in English, and this would cause delay and change in construction.

Blueprints are considered the language of industry. They are the engineer's means of explaining to the workmen what he wants done. The working drawings made by a German engineer could be understood and followed by an American workman, with the exception of a few German notes that would be made on the drawing. All the lines of the drawing would be the same no matter in what country or industry it was drawn even though the unit of measure be different. The workman who wants to advance with industry and be able to meet changes that take place should prepare himself by learning to read the language of industry, which is the blueprint made by the engineering department of the company for which he works.

The draftsman makes his working drawings on thin white tracing paper, or a high grade of cloth, which has been starched and treated so that it is transparent. The paper is used for jobs which are temporary or in cases where permanent records are not necessary. The cloth is much more expensive and is used where the working drawing must be kept for many years. These working drawings on either cloth or thin paper are used in making blueprints in the same way that the negative of a photograph is used to make a print. Blueprint paper is yellowish green on one side and white on the other side. A bright light will make it change color so it must be kept in a dark room. In making a blueprint the working drawing is placed over the blueprint paper and the sunlight or the light from an electric arc allowed to shine through the tracing paper. The lines, either ink or pencil, keep the sunlight from shining on the blueprint paper so that the color of the blueprint paper changes every place except where there are lines on the tracing paper. The blueprint paper is then taken out of the light and placed in water where the color change is completed.Every place where there were lines turns white, and the rest of the paper turns blue, and so we have a blueprint. The working drawing may be used to make as many copies or blueprints as are needed. After the blueprints have been made, the tracings or working drawings are stored in a dry place and kept as records. If the blueprint happens to be of a pump base and the engineering department decides to install a new pump or change the pump house in any way, the engineer can go to the filing room and get the original working drawing at any time and know exactly what is in the pump house and make changes without having to make a trip to the location.

2. Use of Blueprints in Industry:

The blueprint made from an accurate working drawing should have all the information needed for the workmen to do the job. Before the workman asks for more information he should first read every note and symbol on the blueprint. He should remember that the blueprint is an exact copy of the working drawing on file in the drafting room, and if he follows every detail and note on the blueprint, he will be protected in case of error. If he checks accurately with the blueprint, the blame will be placed squarely on the draftsmen in the office.

A working drawing shows an object from one or more sides with all lines and all angles drawn exactly as they are. All dimensions or measurements, the radius of any curve, the kind of material, the finish of the surface, and any other notes necessary to fully describe the object should be given on the working drawing. The working drawing usually shows three views of the object and there is usually a note to tell whether it is a front view, the top view, the plan, the end view, or whatever it may be. The workmen should remember that the blueprint was put in water in developing and a piece of paper that has been wet shrinks up so that measurements made with a rule on the blueprint are not accurate. The result is that the workman shall take all measurements as they are figured out and shown on the blueprints by dimension lines and only make measurements when the draftsman has failed to put on a dimension. An accurate blueprint will give all measurements and all information necessary to complete the object.

The engineering department spends considerable money in providing blueprints for the workman and the least that the workman should be expected to do is to take care of the blueprints. The blue color will fade if left exposed to the sunlight for any length of time, so the workman should take care that blueprints are not left exposed to the sunlight when not in use. The blueprints are usually 24 inches by

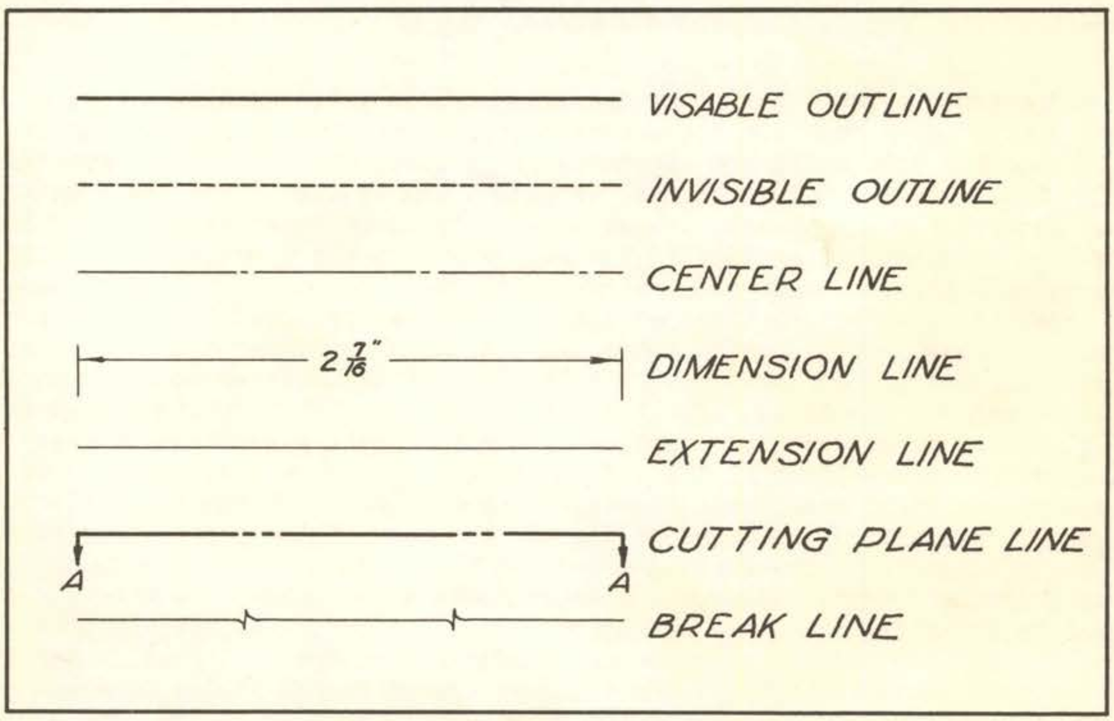


Fig.1

36 inches or some other size which may be decided upon by the engineering department. It is necessary, therefore, to have some way of folding or rolling the blueprints, and the usual method is to roll them. The workman should take care to preserve the blueprint in whatever form he receives it, and never fold it if it was intended to be rolled.

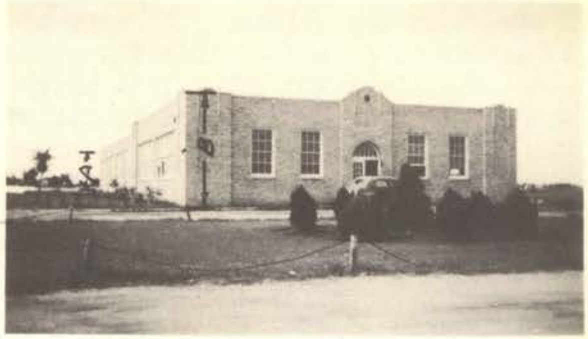


Fig. 2

In order to read blueprints the workman must know something of the principles of making working drawings. This is quite a bit like learning a new alphabet and to read a printed page. The workman should first understand that a blueprint is a record of instructions given to him to read. Secondly, he should realize that the language used by the draftsman is largely a language of lines and that unless he knows how to read the lines, the instructions recorded on the blueprint are almost in a foreign language.

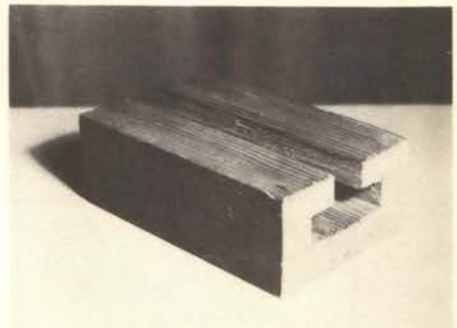


Fig. 3

Fig. 1 shows the more common lines which go to make up the language of industry. The visible outline is a heavy white line on the blueprint and is used to represent the lines of the object which can be seen from the side that is being drawn. The dotted line called the invisible outline is used to represent any line in the object which cannot be seen. The dimension line is a light white line on the blueprint which is used to indicate the distance

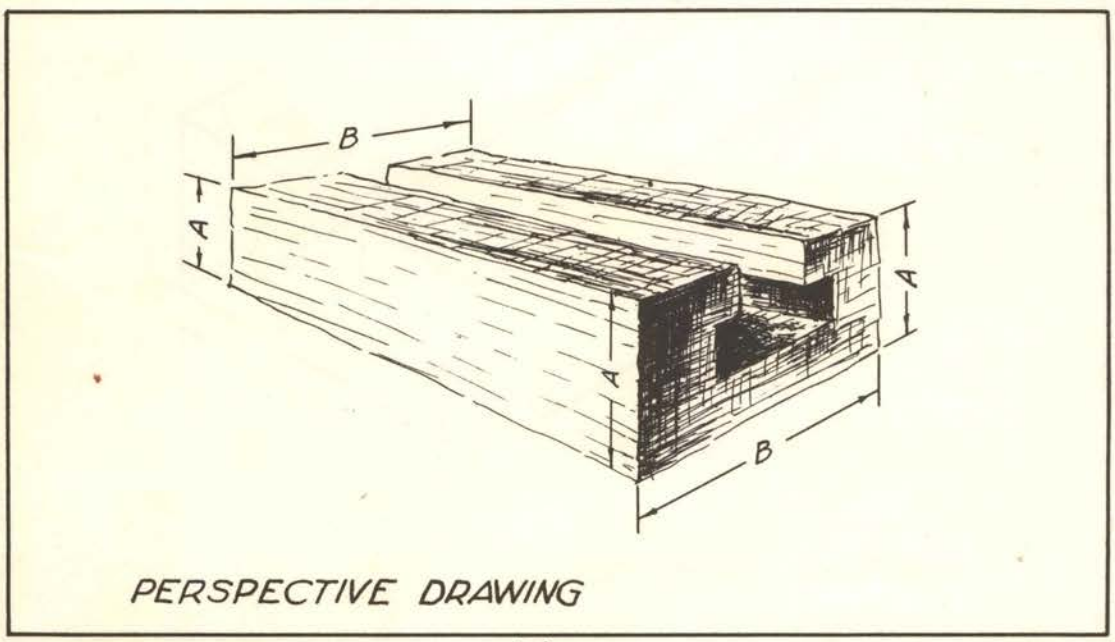


Fig. 4

between any two points. The extension line is also a light solid line which is used to extend to points outside the object so that the draftsman will have more space to place the dimension line. The heavy line with two dots and a long dash and the arrows pointing to each end is called the cutting plane line and is used to show where sections are taken. This is necessary in the case of complicated objects because the regular views do not clearly show the shape of parts inside the object. The break line is used to show that a part of the object has been left out because it was too large to be drawn on the paper.

After the workman has become familiar with these lines he has completed his first lesson in learning the language of blueprints. In order to read a blueprint, the first thing to do is to study the different views until one has a mental picture of what he is to build. The drawings all are made on a flat sheet of paper and it is necessary to study these and use the imagination to make the lines and views stand up off the paper and obtain a mental picture. Next, all letters and notes should be read and considered. Carelessness in any one of these respects is not to be excused.

3. Freehand Isometric Sketching:

A pictorial drawing is any kind of drawing which resembles a picture. Fig. 2 shows an actual photograph of a building. We know that the building is the same

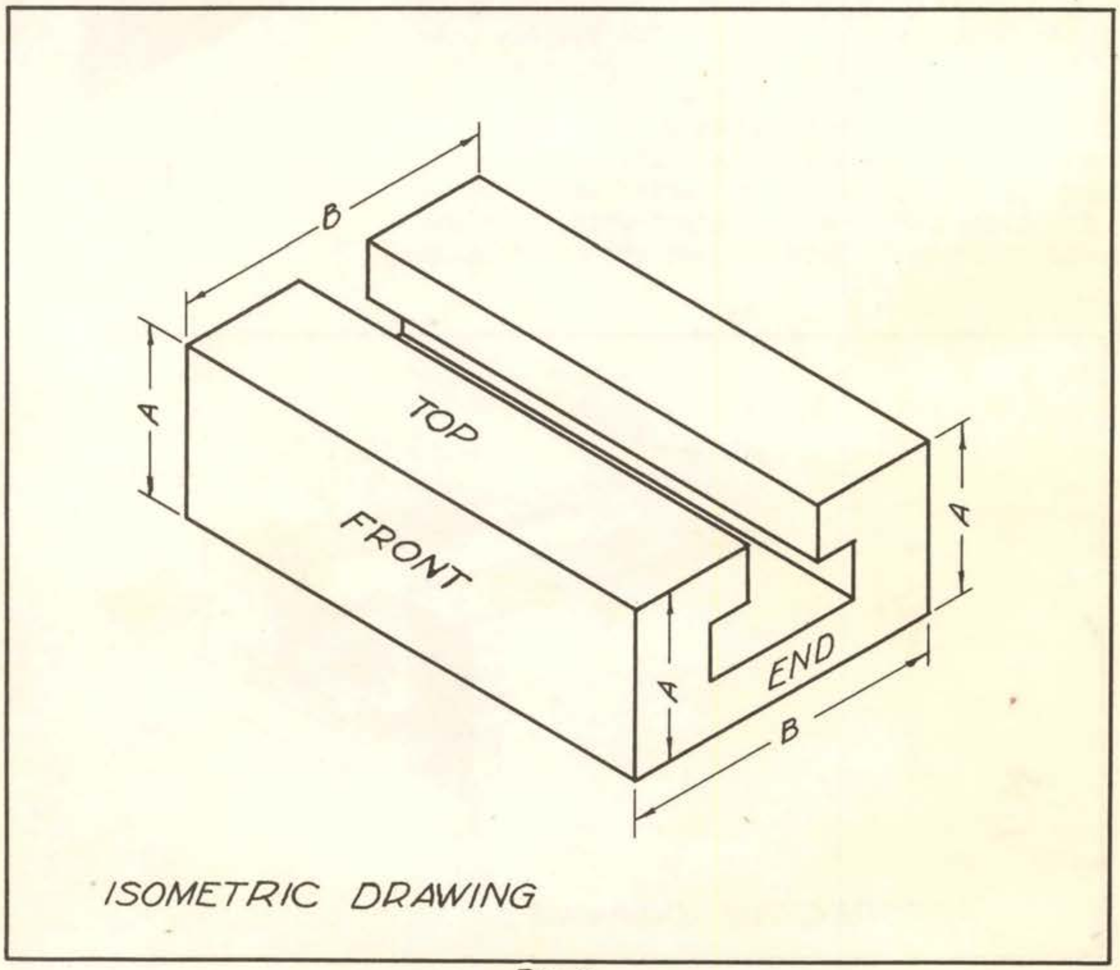


Fig.5

height in the rear as it is in the front and that the two dimensions marked "A" and "B" are the same, but it can be seen at a glance that they do not show up equal in the picture. The picture gives a very clear mental image of the building but it gives no information that will help the workman to construct the building. Therefore, it is plain that a photograph is of little value to the workman.

Fig. 3 is a photograph of a block. It shows very clearly the shape of the block and again the workmen get a very clear mental image, but it will be noticed that the information is not such that he could actually make the block.

Fig. 4 is a perspective drawing of the same block and it will be noticed that the three dimensions marked "A" should be equal but they are not, and likewise the two dimensions marked "B". This form of drawing is similar to an actual photograph inasmuch as it is possible to get a very good mental image but it, too, fails to give sufficient information to be of value to the man in industry.

Fig. 5 is known as an isometric drawing. It will be noticed that the dimensions marked "A" in this drawing are equal and also that the dimensions marked "B" are equal. Some measurements can be made on an isometric drawing and this gives it much more value than a perspective drawing. This form of drawing is becoming more important in the drafting room as it shows a little better picture than the three-view type drawing and the workman should acquaint himself with isometric drawing so that he can become able to make a simple freehand sketch of any part of his work, which will be a valuable aid to him in explaining to a foreman how he did a particular job. There are two other forms of pictorial drawing, the oblique drawing and the cabinet drawing, but as they are used very little in the petroleum industry, they will not be discussed at this time.

4. <u>The Theory of Mechanical Drawing</u>:

Three-view drawing is another name for working drawing. In most cases three views of an object are drawn. The three views commonly shown are front view, side or end view, and top view. A view of an object, for instance, the front view, is almost what one would see if he were directly in front of the object, and, likewise, the top view of an object is what one would see if he were looking directly down on top of it, and in the same way, the end view is what a person would see if he were looking at the object from a point directly out from the end of the object.

Fig. 6 is an arrangement of three photographs of the block. In each case the camera was placed at a point directly out from the center of the front of the block. This operation was repeated using the end view and the top view. These pictures have been arranged in the same order as the draftsman would arrange them in making a working drawing. The dotted lines have been added to the front and top views so as to give the same information as would be given on a working drawing.

These three views have a certain arrangement on the blueprint. The draftsman usually draws the front view first, and the top view is placed up above the front view, and the right end view is placed to the right of the front view, ~~as is shown in Fig. 6,~~ and, if a bottom view were drawn, it must be placed below the front view, and if a left end view were required it must be placed at the left end of the front view. The reason for placing these views in this arrangement is that this is a standard method of making a working drawing, and if all draftsmen are taught to make drawings in this way, and all workmen learn that working drawings are made in this way, then there will be no misunderstanding between the workman and the draftsman. If the draftsman takes a notion to change this arrangement and the workman is not told about the change, it can very easily cause an error, so we learn this arrange-

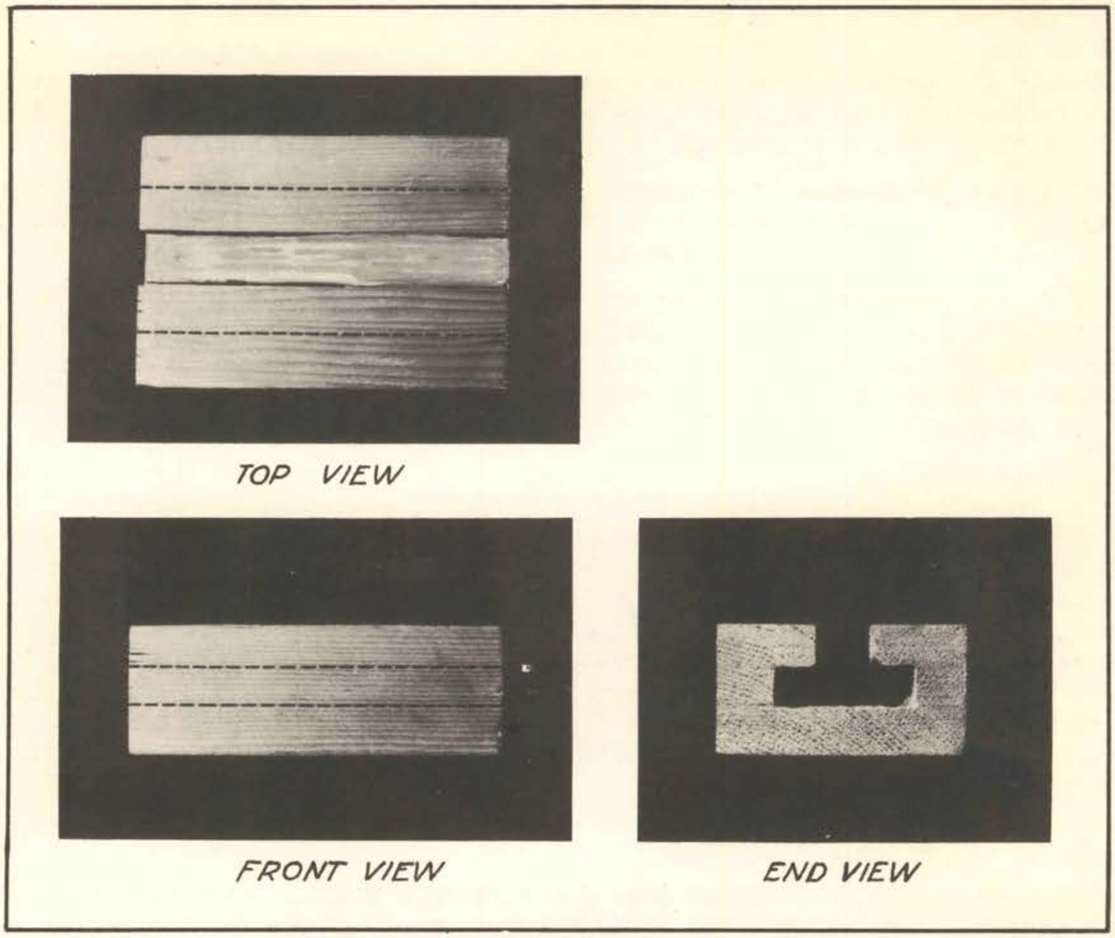


Fig. 6

ment of the views and do not change them.

Fig. 7 shows a three-view drawing of the same simple block that was shown in the preceding figures. Fig. 3 is a photograph of the block. Fig. 4 is a perspective sketch of the block. Fig. 5 is an isometric drawing of the block. Fig. 6 is photographs of three actual views of the block, and Fig. 7 is a working drawing of the block. The student will get a better idea of three-view drawings by going over these figures again and comparing each one with the working drawing. This working drawing is the means industry uses to instruct the workman to do a job.

The shape of an object determines the number of views required to show it. The purpose of a working drawing is to instruct the workman on what is needed for the job and how to make it. In the case of a section of six-inch pipe four feet long, the end view of the pipe would show the outside diameter of the pipe, the thickness of the pipe, and the inside diameter. The front view of the pipe would give the length and a top view would be exactly like the front view, so that the front and end views are all that would be necessary. As the object becomes more complicated more views will be required. In the case of a complicated pipe hook-up, 3 or 4 views will be necessary to give the workman all of the required dimensions and, in some cases, the draftsman will furnish an isometric drawing to give the workman a little better picture of how all the parts will be arranged and assembled, so that the number of views required are the number of views that are necessary for the

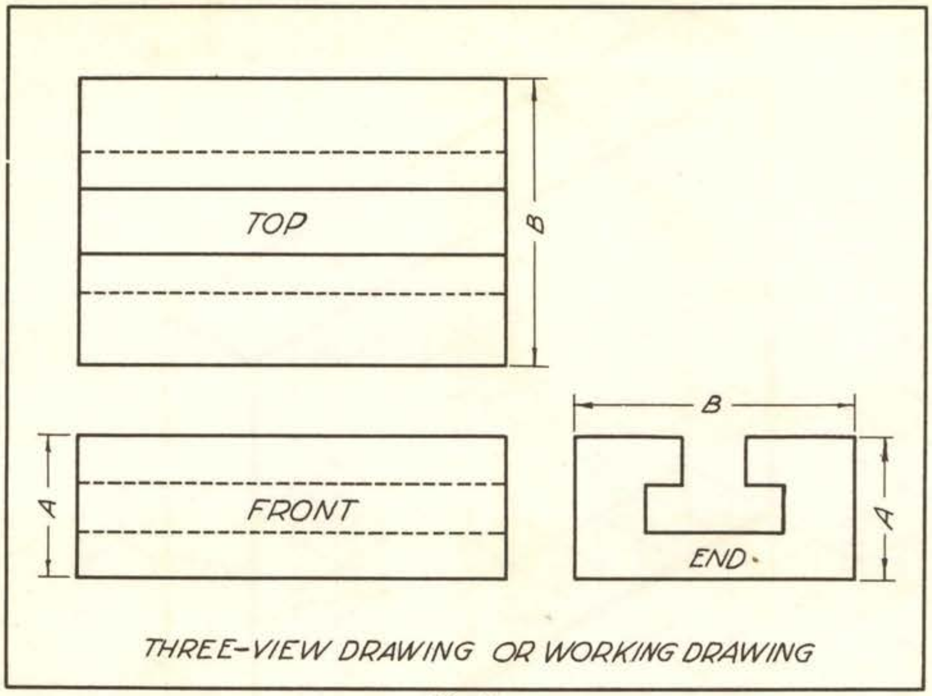


Fig 7

workman to get the job done.

5. Kinds of Drawings:

Drawings are divided into two principal classes, pictorial drawings and three-view drawings, as has been mentioned. The pictorial drawings are divided into four types; perspective, isometric, oblique, and cabinet. The isometric drawing is the important one of these and its use is becoming more general. Working drawings or three-view drawings may be classified according to type of work, for instance, sheet metal drawings, piping drawings, architectural drawings, machine drawings, structural steel drawings, etc. In the petroleum industry the worker must know a little about each of these types of working drawings because even though he may be employed in one branch of work, for instance, pipe work, occasionally he will have a job which deals with sheet metal work. The principles of working drawings are the same regardless of the kind of work, and a good draftsman is capable of making several types of drawings.

6. Making Isometric Sketches from Three-View Drawings:

The ability to read a blueprint is to be able to study a blueprint and form a mental picture of the object represented by the working drawings. If the student can study a blueprint and make a mental picture, he should be able to make the picture on paper. The sheet of paper with the diagonal lines at the back of this book is known as isometric ruled paper. If a sheet of typewriting paper or other reasonably thin paper be placed over this isometric paper the isometric lines can be seen through the typewriting paper. If the student has studied the working drawing in Problem 1 and has formed a mental image of the object he should next place a sheet of typewriting paper over the isometric paper and draw the isometric drawing of the object, which is a simple block of wood. The heavy lines of the ruled paper are one inch apart and the lighter lines give half-inch spaces, so that by using this method of sketching, it is not necessary to use a ruler for making measurements and a

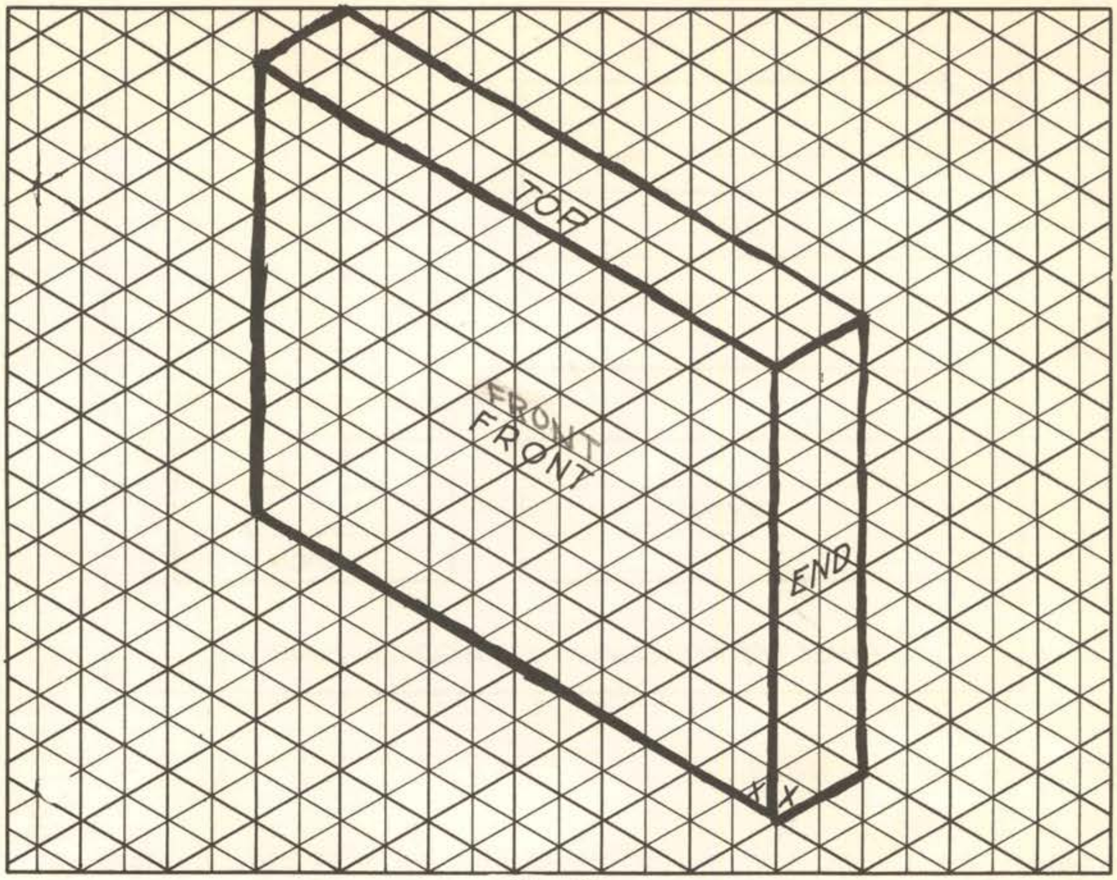
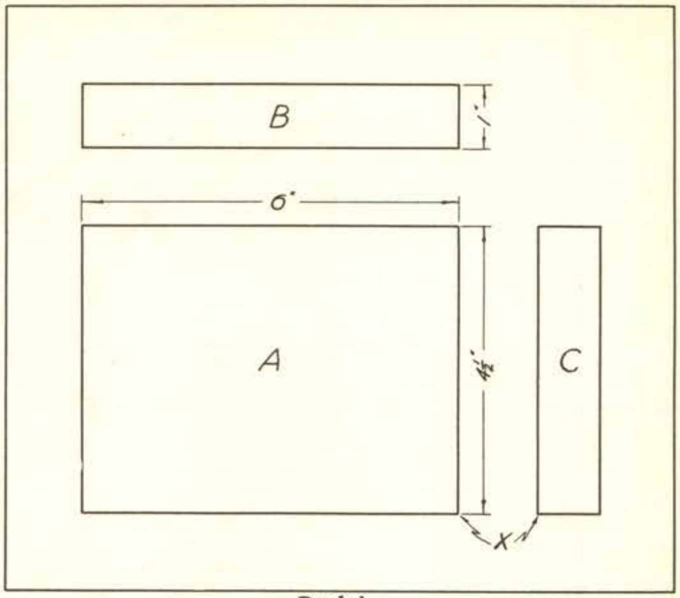


Fig 8

reasonably accurate drawing is obtained. All lines should be made freehand as ability to draw freehand is the result of practice.

Fig. 8 will illustrate how the object should be drawn. The corner of the object should be drawn. The corner of the object marked "X" should be placed well towards the bottom of the sheet at the intersection of three heavy lines. These three heavy lines on which the drawing is started are called the isometric axes. The isometric axes always are located before the drawing is started. Complete the three views of the isometric drawing by taking the information necessary off the working drawing. After the student has finished the isometric drawing of Problem 1, he should answer the following questions about the working drawing. Although these problems look very simple, the student will find it well worth his time to make carefully a freehand sketch of each problem as directed and answer carefully each question asked about the problem.

Problem No. 1



Prob.1

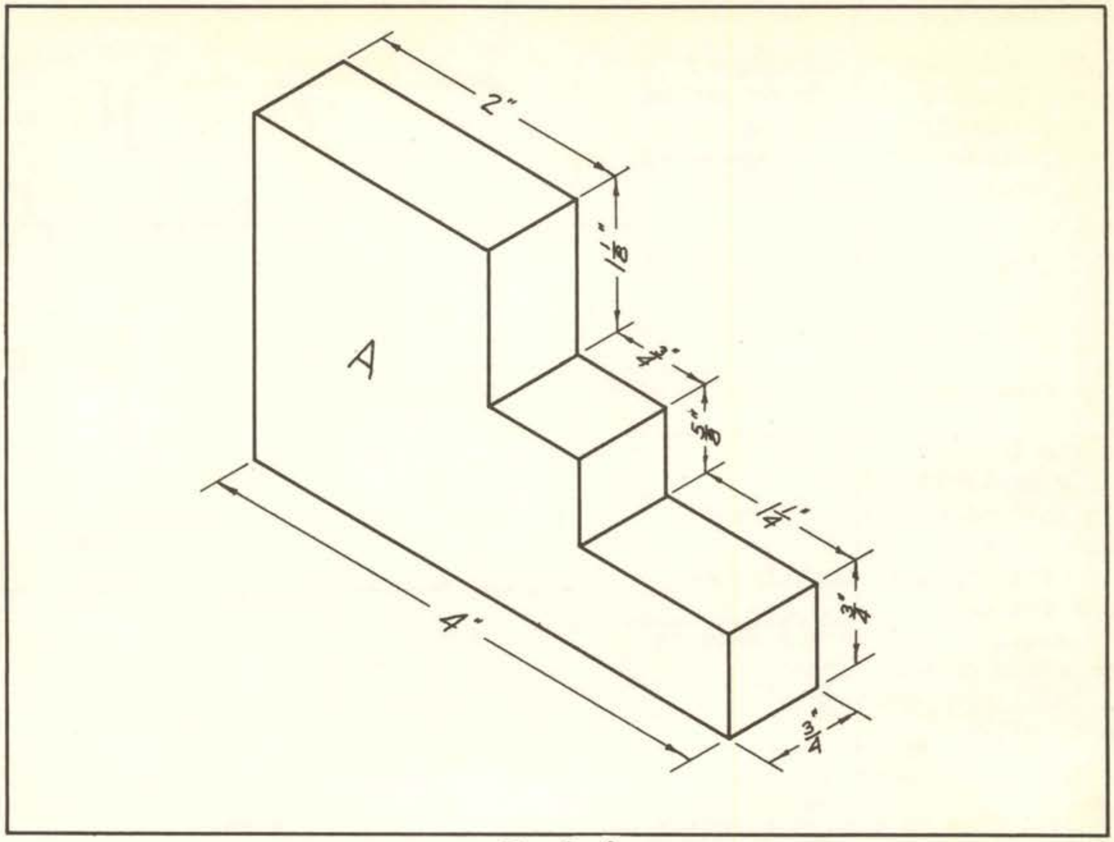
Make an isometric drawing of this block placing the corner marked "X" on the isometric axes. Do not dimension. Questions to be answered about the working drawing on this sheet:

1. What view shown above is labelled "A"? ________________
2. What view shown above is labelled "C"? ________________
3. What view shown above is labelled "B"? ________________
4. Is the front view longer horizontally or vertically? ___________
5. The thickness of the block is shown in what views? ___________
6. The width of the block is how many inches? ______________
7. The width of "A" is the same as the width of what view?_________
8. Is "B" longer horizontally or vertically? __________________
9. Is "C" longer horizontally or vertically? ________________
10. The top view is always directly above the ____________view.
11. In a three-view drawing we see the__________form.
12. The working drawing uses three views to show the block while the isometric drawing shows the block in but __________view.
13. Each of the views drawn in the working drawing form a geometric figure called _____________.

Now, in order to see if the student has learned what a working drawing is, Problem 2 will be just the opposite. An isometric drawing of a gauge block is given and the student is to make a three-view drawing. Rectangularly ruled paper will be found in the back of the book and if a sheet of typewriting paper be placed over it, the lines will show through and this will save the trouble of making measurements and also will be helpful in drawing straight lines freehand.

The views should be arranged in the proper manner and the dimensions given so that sufficient information is given to enable a workman to make the gauge block.

This kind of drawing is used by many men in the field and in many cases, blueprints are made by the engineering department from such sketches sent in by foremen and workmen.

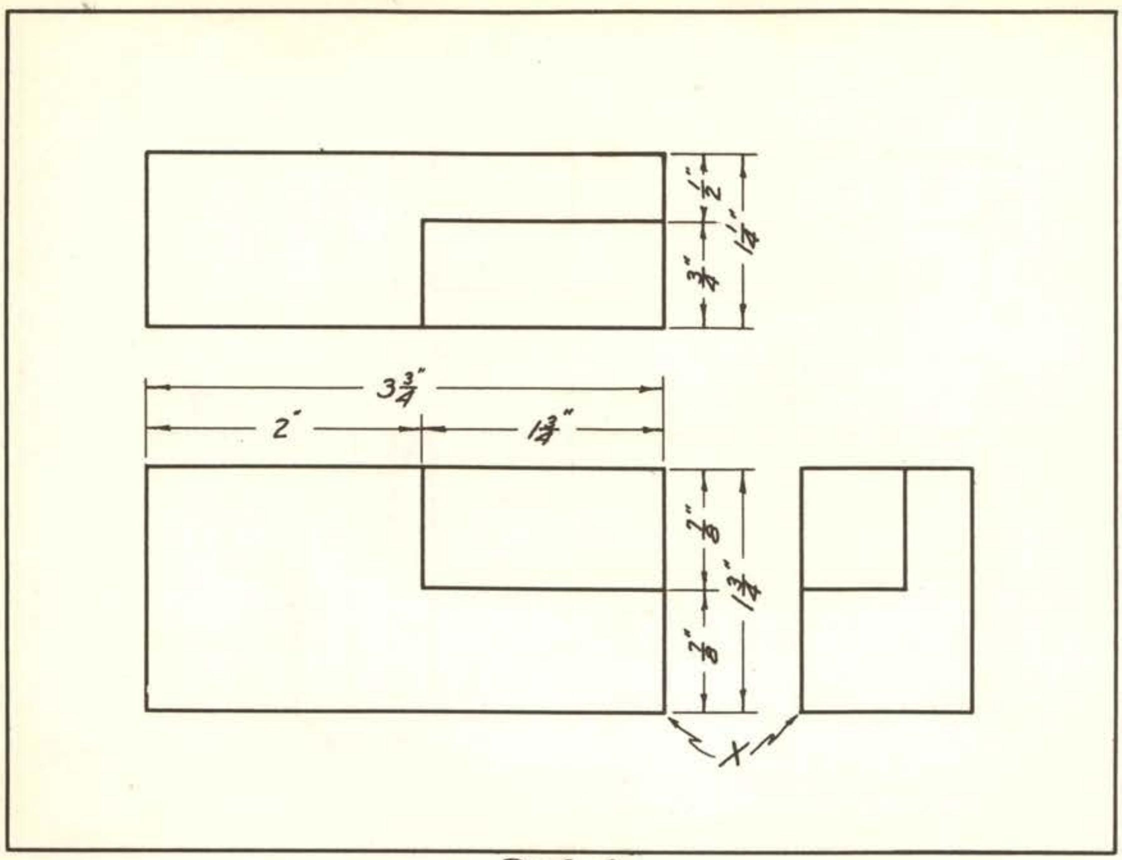


Prob. 2

Problem No. 2

Make a three-view drawing of this gauge block using side "A" as the front view. Questions to be answered after the drawing has been completed:

1. Straight lines that never meet, no matter how far they are extended are called ______________lines.
2. Any line drawn at 90° with a horizontal line is called a __________line.
3. The longest dimension in the front view is_________inches.
4. The right end view is placed to the right of the________view.
5. The block is made of material of what thickness? _______________
6. The top and end views form geometric figures called _______________
7. The shortest dimension on the block is how much? _______________
8. What size piece of boiler plate would be required to make this block? _______________

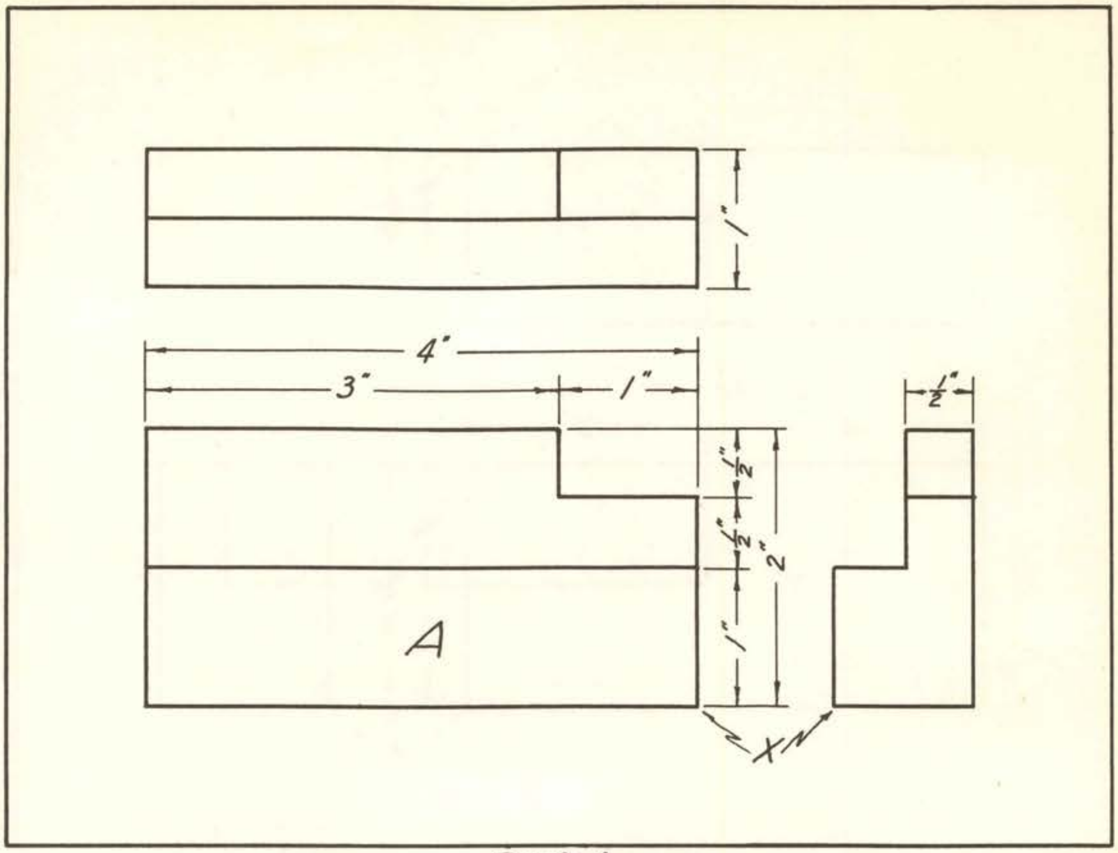


Prob. 3

Problem No. 3

Make an isometric drawing of this notched block placing the corner marked "X" on the isometric axes. Questions to be answered about the working drawing on this sheet:

1. The size of the piece taken out of this block is____x_____x_____.
2. The intersection of two planes in the front part of an object is shown by a ______________line.
3. The shortest dimension on the block is_______inches.
4. The longest dimension on the block is________inches.
5. How many views are needed to show the shape of the notch? _______________
6. The width of the right side view can be obtained from what view?_______________
7. The length of the top view can be obtained from what view? _______________
8. Which two views show the thickness of the block? _______________
9. An angle of 90° is called a________angle.
10. How many right angles are there inside a rectangle? _______________

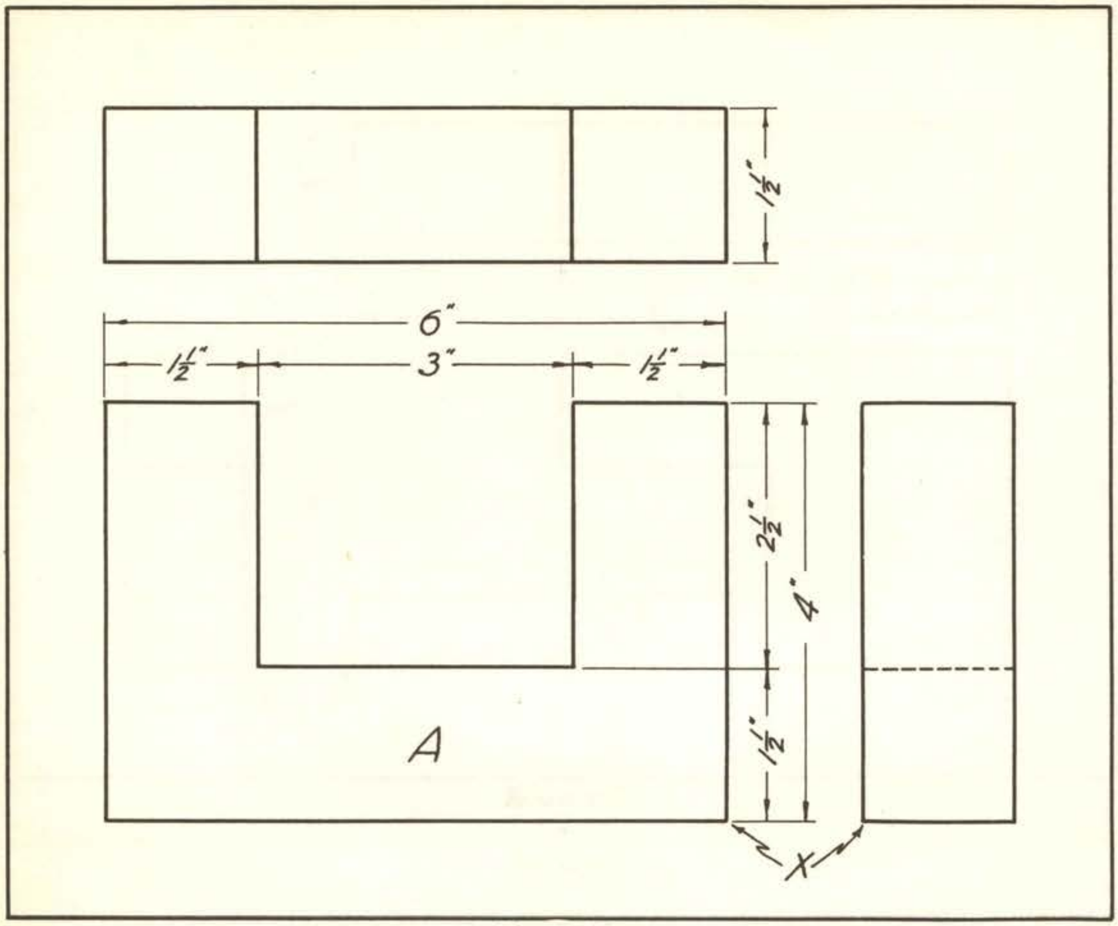


Prob.4

Problem No. 4

Make an isometric drawing of this block placing the corner marked "X" on the isometric axes. Questions to be answered about the working drawing on this sheet:

1. Isometric drawing is a form of__________drawing.
2. The over-all length of the block is_______inches.
3. The over-all width of the block is_______inches.
4. Mark an "X" on the line in the right end view which represents surface "A".
5. The isometric axes are at an angle of how many degrees with each other? _______________
6. Measurements in making isometric drawings can be made only on the______axes or on lines________to it.
7. What must one do to the right side view to make it a complete rectangle? _______________
8. Considering that two pieces are cut from the block, what are the dimensions of the largest pieces removed? _______________
9. What size piece of material would be required to make this block?___x____x_____
10. Is the top view in this drawing necessary? _______________

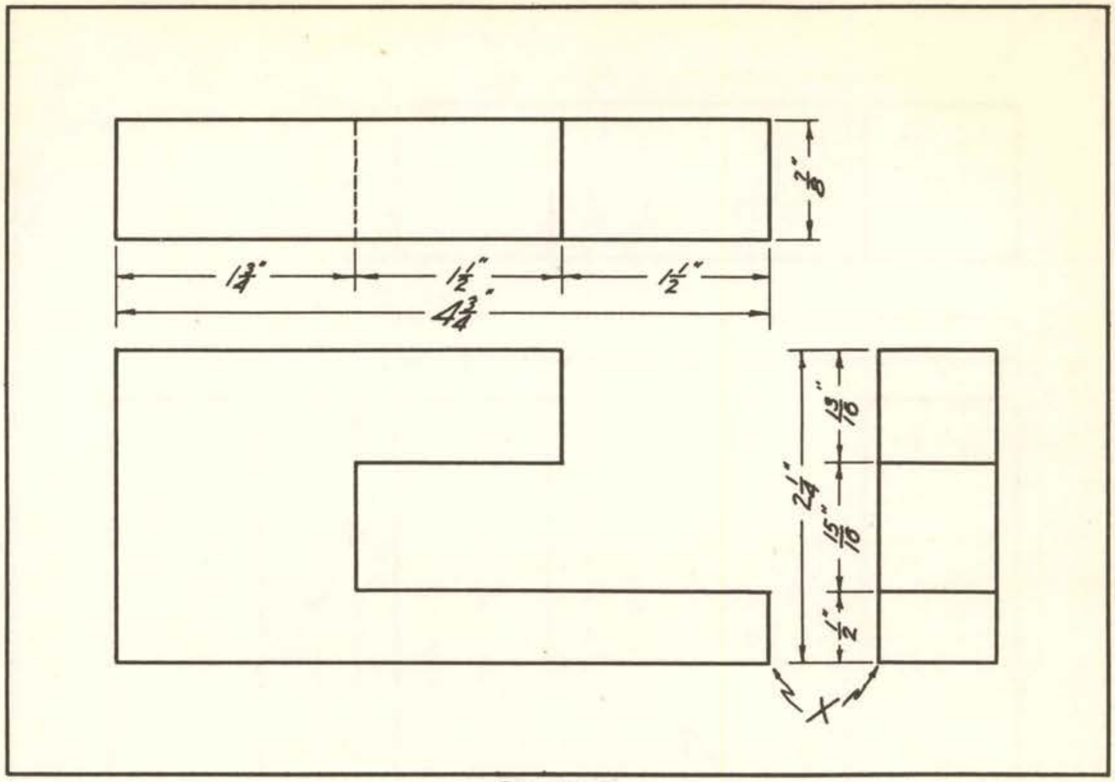


Prob. 5

Problem No. 5

Make an isometric drawing of this block, placing the corner marked "X" on the isometric axes. Questions to be answered about the working drawing on this sheet:

1. Why is the side "A" used as the front view? _______________
2. Why doesn't all of the notch in the isometric drawing show? _______________
3. If the shape of the notch was shown in the isometric drawing, it would have to be with a____________line.
4. Which view of the working drawing most clearly shows that a notch has been cut out of the block? _______________
5. The depth of the notch is shown on the right side view by a______line.
6. An edge which is behind some other part of the object is shown by a_____line.
7. In case an invisible line is directly behind a solid line it is________shown.
8. The size of the piece cut out of this block is_______thick,______wide, and ________long.
9. There are no dotted lines in the top view because _________________.
10. What size piece of stock is required to make this block?_____________

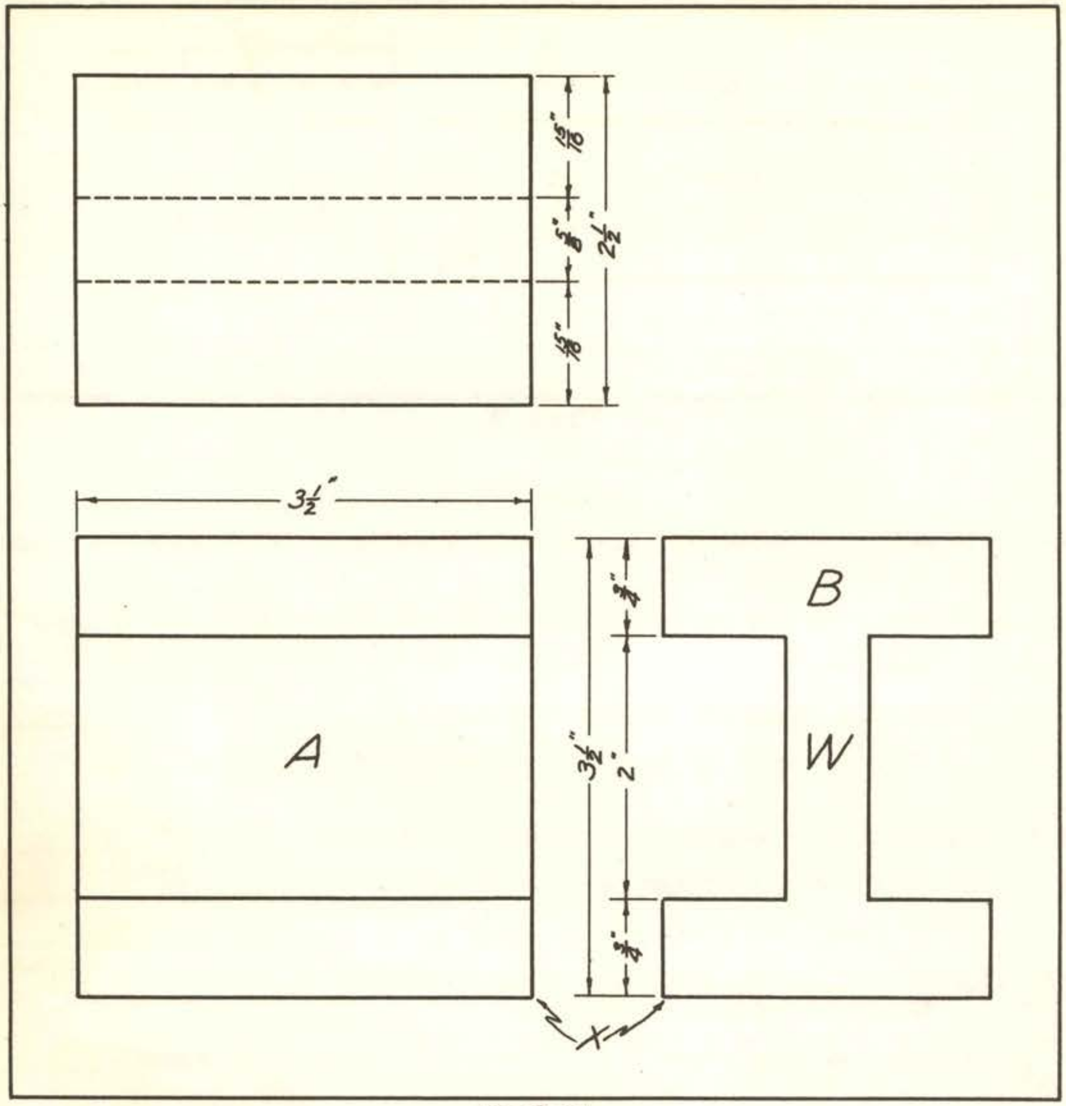


Prob.6

Problem No. 6

Make an isometric drawing of this block, placing the corner marked "X" on the isometric axes. Questions to be answered about the working drawing on this sheet:

1. The only invisible line in the working drawing is in the___________view.
2. What size piece of stock would be required to make this block? _____________
3. The end view makes a geometrical figure known as a___________.
4. What are the over-all dimensions of the piece cut out of the block?___________
5. What kind of a line is used to show an invisible surface? ____________
6. Which line is drawn heavier, an invisible outline or a dimension line?________
7. Which view of the working drawing most clearly describes the shape of the block? _____________
8. How long is the top of the block? _____________
9. How long is the bottom of the block? _____________
10. What is the shortest dimension in the working drawing? _____________

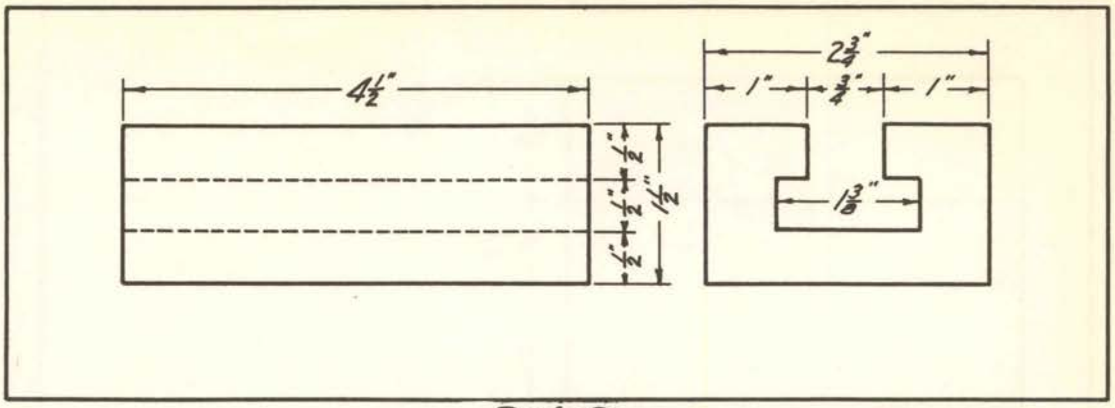


Prob.7

Problem No. 7

Make an isometric drawing of this I-beam. Questions to be answered about the working drawing on this sheet:

1. How many invisible lines are there in the drawing? _______________
2. These invisible lines represent the intersection of the web "W" and the top piece marked___________.
3. The web of the I-beam is_________inch in thickness.
4. Why are there no invisible lines in the front view? _______________
5. Which view most clearly gives the shape of the object? _______________
6. How thick are the flanges of the I-beam? _______________
7. What is the distance from the under side of the top flange to the bottom of the beam? _______________
8. What are the two dimensions of surface "A"? _______________

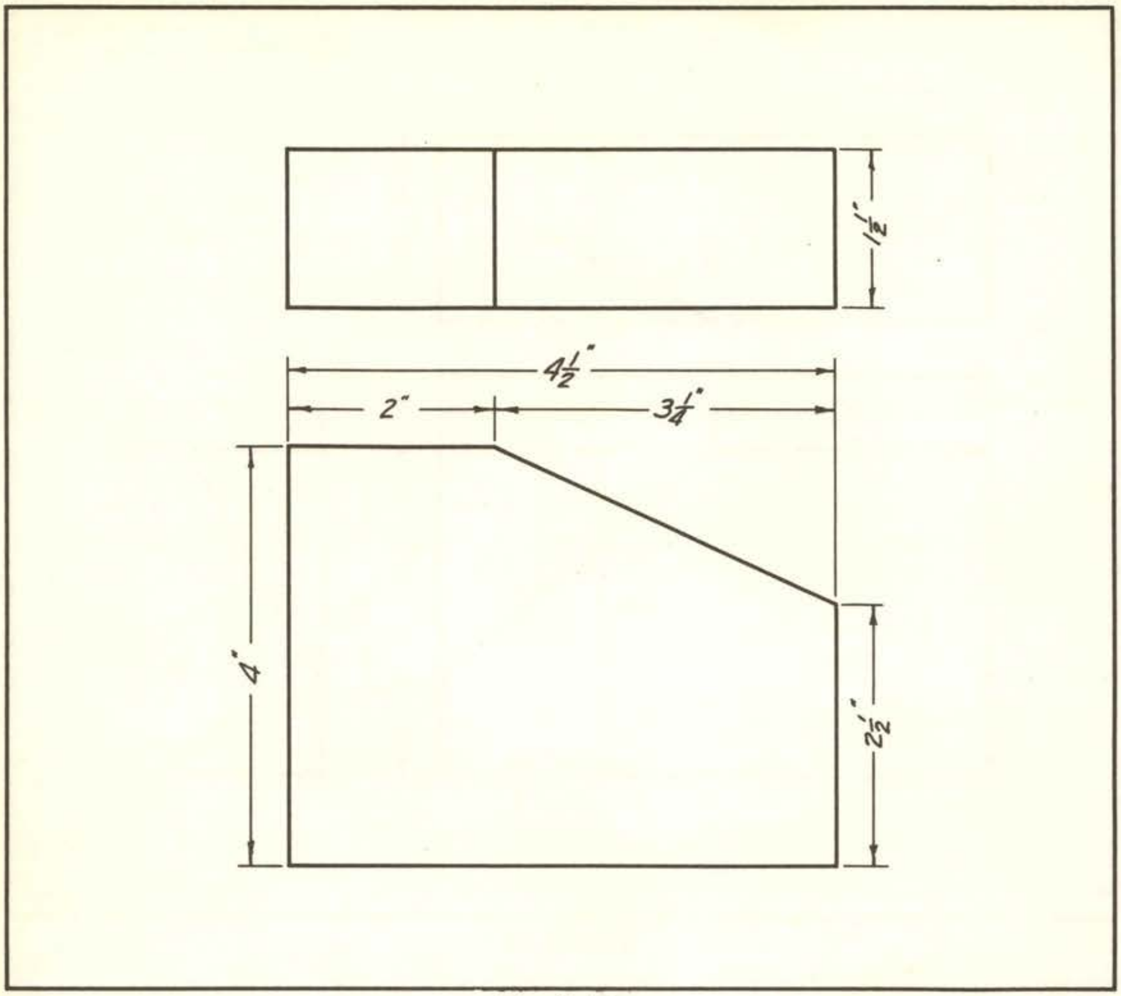


Prob. 8

Problem No. 8

Make an isometric drawing of this block. Questions to be answered about the working drawing on this sheet:

1. Would two views give the workman enough information to make the block? Why? ________________
2. How many invisible lines are in the drawing? ________________
3. The depth of the "T" slot is shown on an invisible line in the___________view.
4. What is the width of the slot at the upper part of the block? ________________
5. What is the width of the bottom part of the slot? ________________
6. What view best shows the shape of the slot? ________________
7. In the alphabet of lines, invisible lines are made ____________than the outline lines.
8. What determines how many views a draftsman will make of an object?_____________

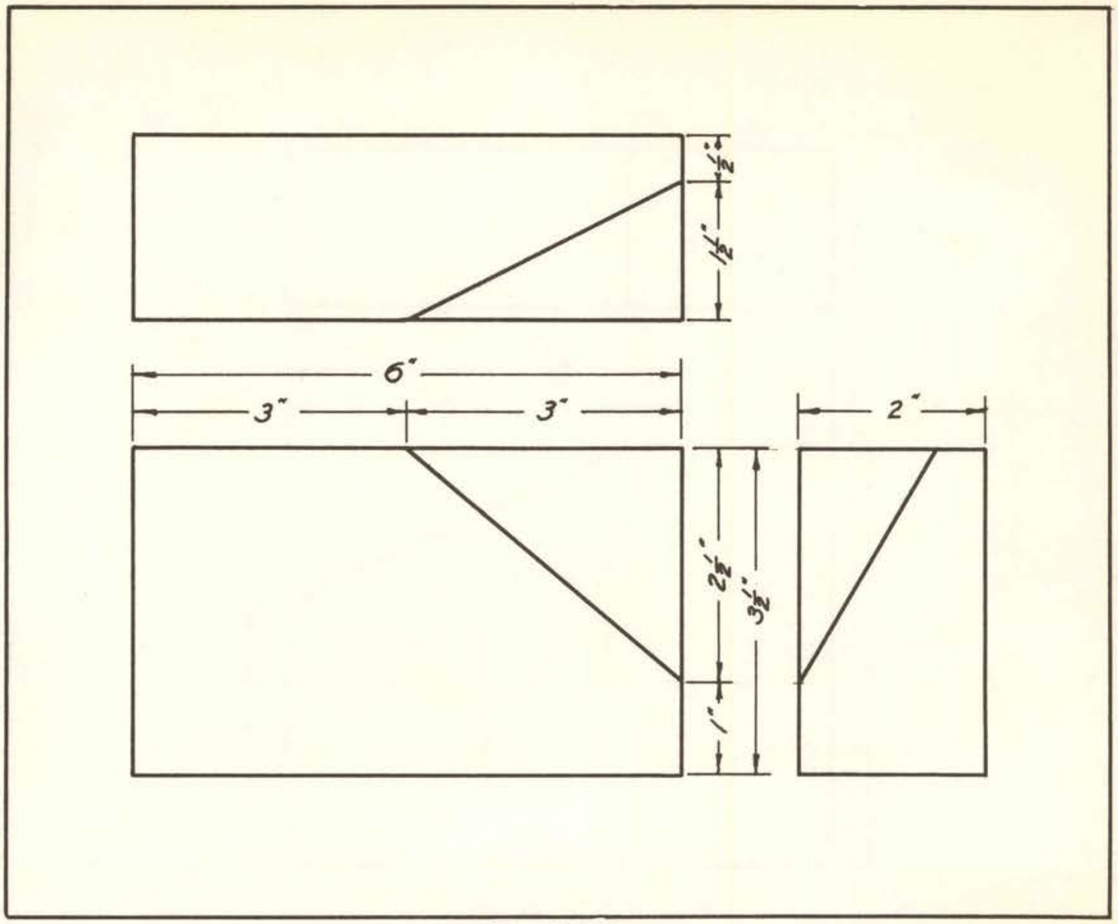


Prob.9

Problem No. 9

Make an isometric drawing of this block. Questions to be answered about the working drawing on this sheet:

1. The true length of the sloping surface is shown in the___________view.
2. The best procedure in drawing a sloping line when the angle is not shown is to locate its____________points.
3. All measurements in isometric drawings must be made along the________________.
4. The front view contains three right angles and two other angles larger than right angles which are called___________angles.
5. Do the two views of this object give the workman enough information to enable him to make the object? ________________
6. Is there a dimension in the working drawing which gives the true length of the sloping surface? ________________

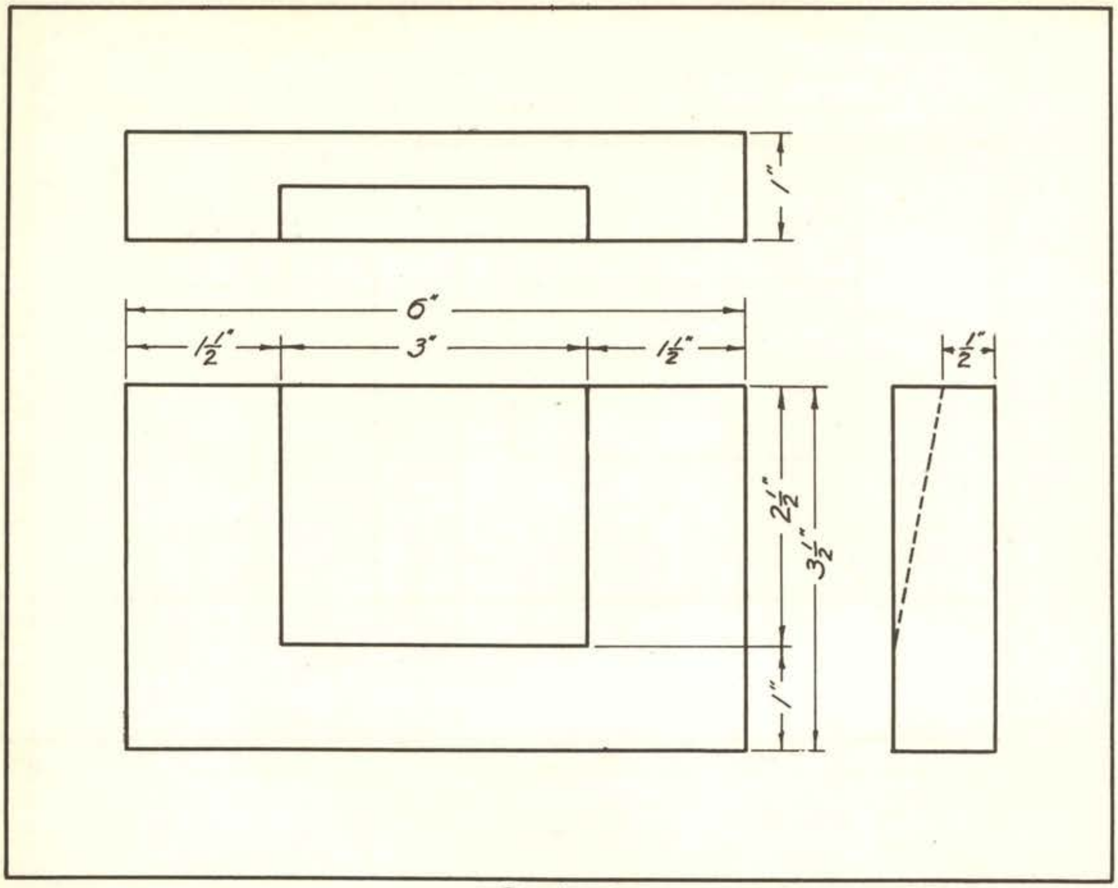


Prob. 10

Problem No. 10

Make an isometric drawing of this block which has had a corner cut off it. Questions to be answered about the working drawing on this sheet:

1. Does the slanting line in the end view show in its true length? ______________
2. Does the slanting line in the top view show in its true length? ______________
3. In drawing slanting lines it is usually best to locate the____________points.
4. The true shape of the sloping surface is shown in which of the three views? ______________
5. Would less than three views enable the workman to make the object?____________

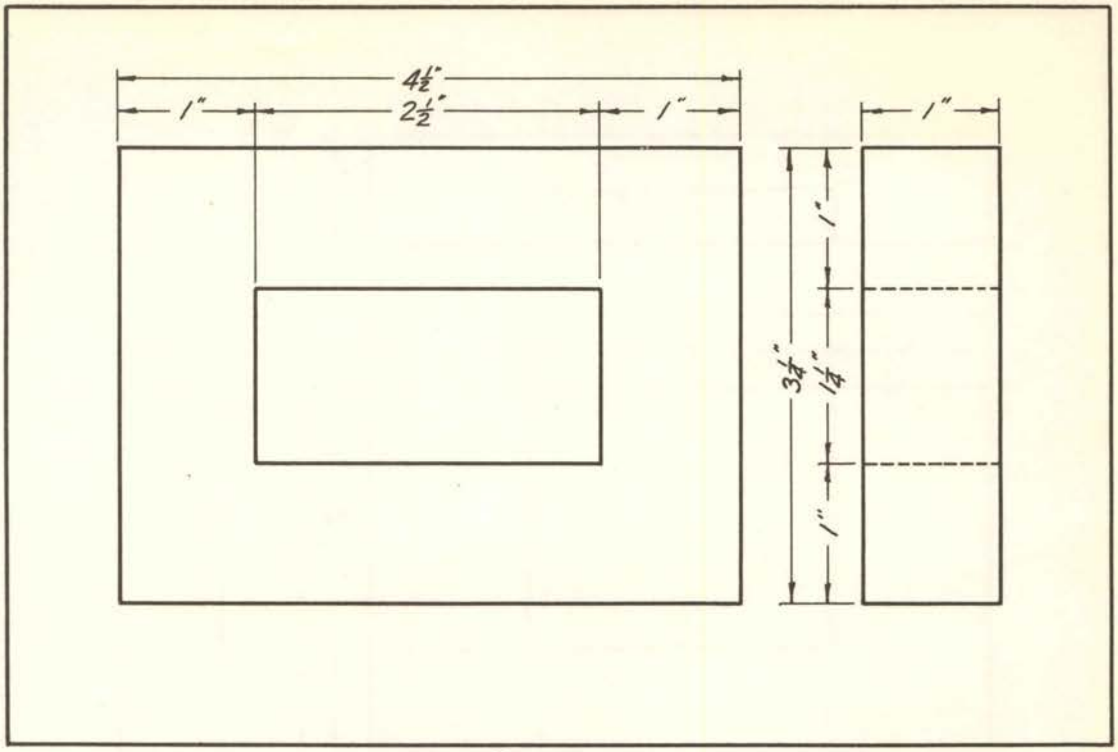


Prob. 11

Problem No. 11

Make an isometric drawing of this block. Questions to be answered about the working drawing on this sheet:

1. Which view shows that the notch is slanting? _______________
2. The lines on which the figures are placed are called_____________lines.
3. The lines which extend out from the drawing in order to show exactly where the dimensions begin and end are called_______________lines.
4. Arrow heads should always_____________the extension lines.
5. The line between the enumerator and denominator of a fraction should be in line with the_______________line.
6. Would less than three views enable the workman to make this object? Why?

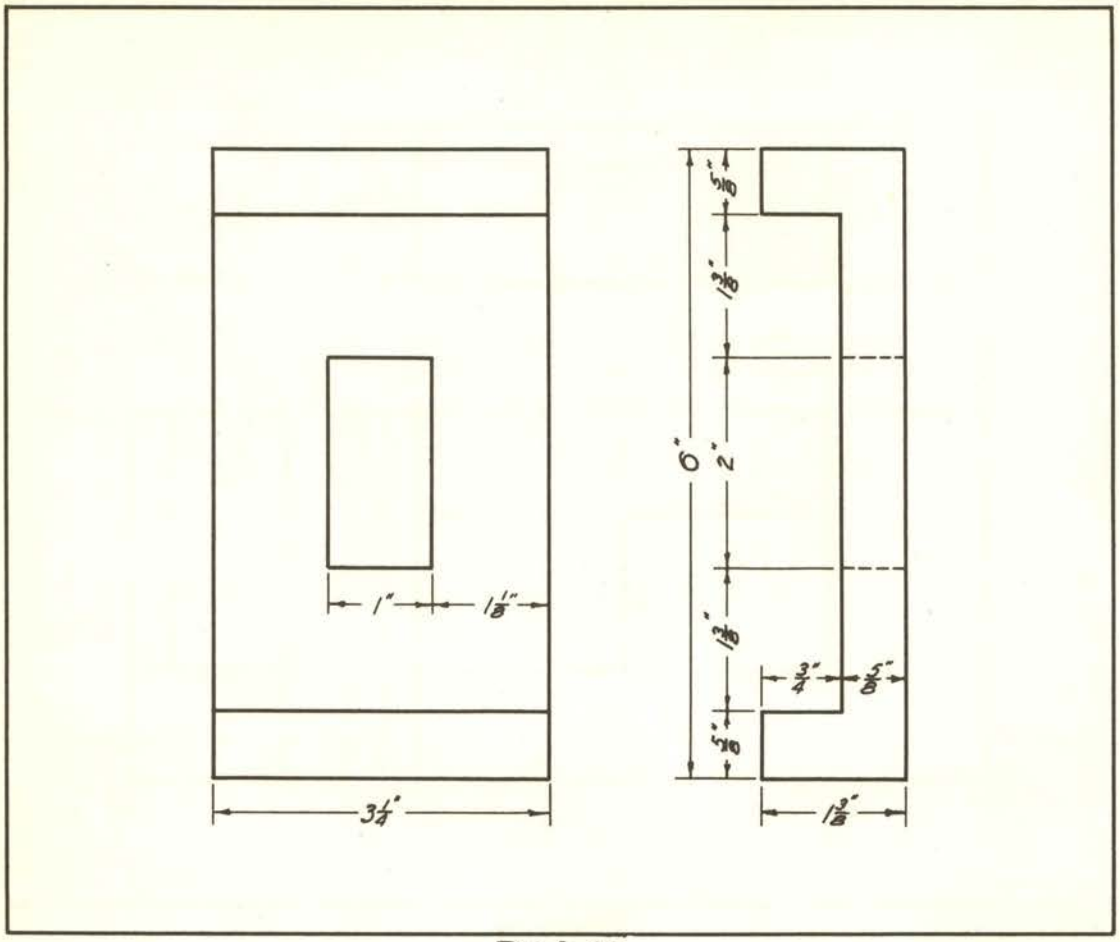


Prob. 12

Problem No. 12

Make an isometric drawing of this block. Dimension the drawing. Questions to be answered about the working drawing on this sheet:

1. What are the dimensions of the piece cut out of this block? ______________
2. Which view shows that the hole goes all of the way through? ______________
3. What are the over-all dimensions of the block? _____x_____x___
4. Which view shows the thickness of the block? ______________
5. Do the two views give the workman enough information to make this block? ______________
6. Which view gives the better mental picture of the block? ______________

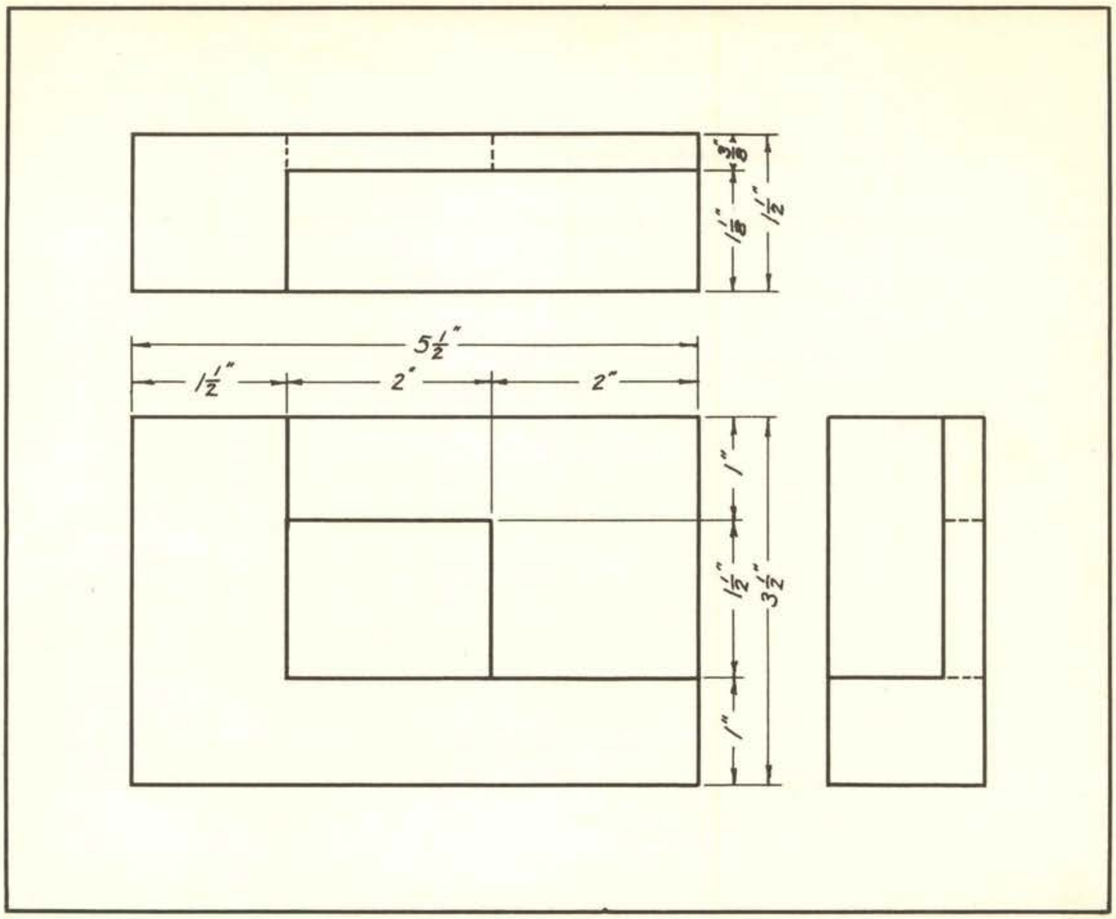


Prob. 13

Problem No. 13

Make an isometric drawing of this section of channel iron. Dimension the drawing. Questions to be answered about the working drawing on this sheet:

1. How thick is the web of this channel iron? ______________
2. How thick are the flanges? ______________
3. What is the size of the hole cut in the web? ______________
4. What is the distance from the bottom of the flange to the hole? ______________
5. Which view shows that the hole goes all the way through the web? ______________
6. Which view shows better the shape of the object? ______________
7. What information do engineers give to describe channel iron? ______________



Prob. 14

Problem No. 14

Make an isometric drawing of this block. Questions to be answered about the working drawing on this sheet:

1. What is the size of the material cut out of the small hole which goes entirely through the block? _____X_____X____
2. Which two views show that the hole goes entirely through the block? _______________
3. What are the over-all dimensions of the block? _______________
4. What is the thickness of the thinnest part of the block? _______________
5. What is the distance from the bottom of the block up to the hole? _____________
6. What is the size of the larger piece cut out of the block? _______________

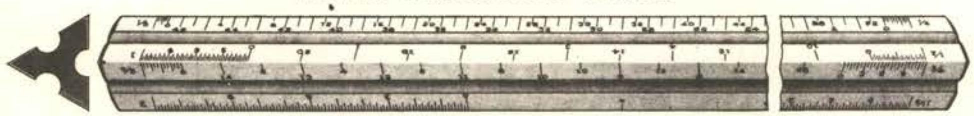
7. Measurements:

The draftsman makes measurements with a tool known as a scale. This resembles a rule with which the workman is familiar. The scale commonly used has three sides as is shown in Fig. 9. It will be noticed that the scale shown is known as an architect's scale divided into the following ratios: 3/32, 3/16, 1/8, 1/4, 3/8, 1/2, 3/4,

Triangular Boxwood Scales

U. S. Standard. Made of Thoroughly Seasoned, Highest Quality Boxwood. Machine Divided.

WHITE CELLULOID FACED



Architect's Scale, 12-inch. Open divided: 3/32, 3/16, 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1 1/2, 3 inches to the foot, 1/16-inch.

Engineer's Scale, 12-inch. Full divided: 10x20x30x40x50x60 parts to the inch.

Fig. 9

1, 1 1/2, and 3 inches to the foot. It also contains a full size scale of 12 inches and divided into sixteenths. This type scale is also available divided into tenths and is used in civil engineering work and is known as an engineer's scale.

A small object would always be drawn full size, that is, if the length of an object were four inches and the width two inches, the draftsman would make the drawing to the actual size. However, it is necessary generally to make the drawing smaller than the actual object. This is done for convenience and this reduction of an object so that it can be conveniently put on a certain size of paper is known as drawing an object to scale.

The foot usually is used as the basis in determining the scale to be used in laying out a drawing. If the scale is half size, it would be written 6" = 1' -0", or half-size; 1/4th size would be written 3" = 1' -0", etc. A scale of 3/4" = 1' -0" means that every three-quarters inch on the drawing represents one foot. A scale of 1/4" = 1' -0" means that every quarter-inch on the drawing equals one foot; a scale of 1/8" = 1' -0" means that every eighth-inch on the drawing equals one foot. Nearly all architectural drawings are laid out on a scale of 1/4" = 1' -0". If the building is very large, this scale is 1/8" = 1' -0". Pump bases, engine houses, foundations, tank walks, and other objects will be drawn to scale, depending upon the size of the object and the size of the paper which the draftsman will have to use.

The student will find it worth his while to obtain a scale and examine it. On one side will be found a foot laid out in standard inches showing sixteenths. This, of course, is a full sized scale. It will be noticed that there are figures printed at the end of the scale. These will be found to be 3, 1 1/2, 1, 3/4, 1/2, 3/8, 1/8, and 3/32. These figures mean that the scale so marked is divided into feet and that the unit marked on the end is taken as the foot. Take the end of the scale marked "3", and it can be seen that the unit is three inches, which is divided into twelve parts. Each one of these twelve parts is divided into eight parts. Thus, the smallest division on the scale 3" = 1'0" is 1/8th of an inch. If it is desired to measure off one foot on this scale, one would start at the zero mark and run to the point marked "1". Then if three inches were to be added to the foot, the three inches would be added out of the foot which is marked in feet and inches. Fig. 10, scale "A", will illustrate how this is done.

Scale "B" represents the scale, 1 1/2" = 1' -0". Here the measurement 2' -9½" has been laid out. Here again the method of scaling was to start at the zero point and run to the 2' point and then returning to the zero point running 9½" into the divided foot. It will be noted that on this scale 1" measures 1/8" on the full size scale. Many large details which the petroleum worker will read will be drawn to this scale and the workman can easily scale these drawings by using an ordinary rule.

Scale "C" is scale 1" = 1'0", and the measurement 4' -4 3/4" has been set off. Scale "D" is the scale 3/4" = 1' -0", and here the measurement 6' -10" has been set off. It will be noticed that the 1" division on this scale is equal to the 1/16" on a full sized scale or the workman's rule. This scale is also used very often on details and such blueprints are easily scaled by using an ordinary rule.

Scale "E" is the scale 1/2" = 1' -0" and the measurement 9' -7 1/2" has been laid off. The next scale on Fig. 10 is the scale 1/4" = 1' -0", and it should be remembered that this is the one to which most architectural and mechanical blueprints are made. On this scale the measurement 20' -6" has been laid off. The last scale in Fig. 10, scale "G", is used for large buildings or any large object in order to use paper of standardized size. Scale "G" shows how 31' -8" would be laid off at the scale of 1/8" = 1' -0".

Each side of the scale is used for two different sized scales. It should be noted that one is just half the other in each case, and this should be remembered in using the scale in order to avoid errors.

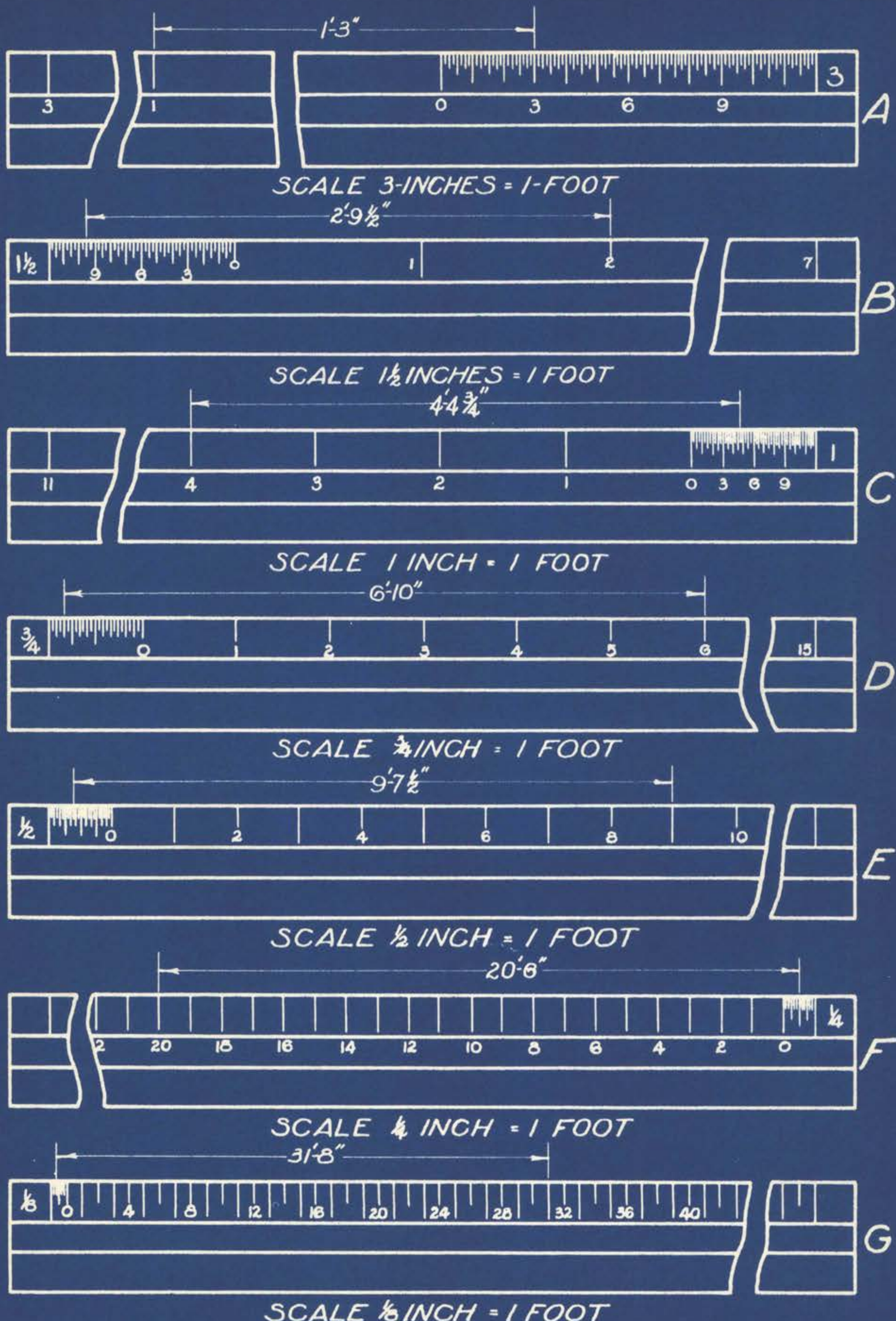
In laying out work, the written dimension should be followed. For example, if you find that the length of a pump base details five feet and seven inches but has a written dimension of six feet and seven inches, make that pump base six feet and seven inches long. You will find the following sentence inserted after each set of specifications: "Where figures are given they are to be followed in preference to measurement by scale." Sometimes the scale is actually shown on the drawing. Where this is done the workman uses it exactly as you would a regular scale.

8. Taking Information off Blueprints:

Many symbols are used on drawings to indicate the kind of finish, kind of material, kind of thread, etc. The draftsman can write the symbol and give the needed information in a very small space where a large space and more time would be required if the information were written out. Fig. 11 gives a few of the common notes and symbols used by the draftsman. The symbol F.A.O. is used when the draftsman wishes to tell the machinist that the machine part being detailed is to be finished all over. Therefore, F.A.O. means finished all over. The student will find many of the symbols and notes shown in Fig. 11 on the problems and blueprints to be presented later in this study.

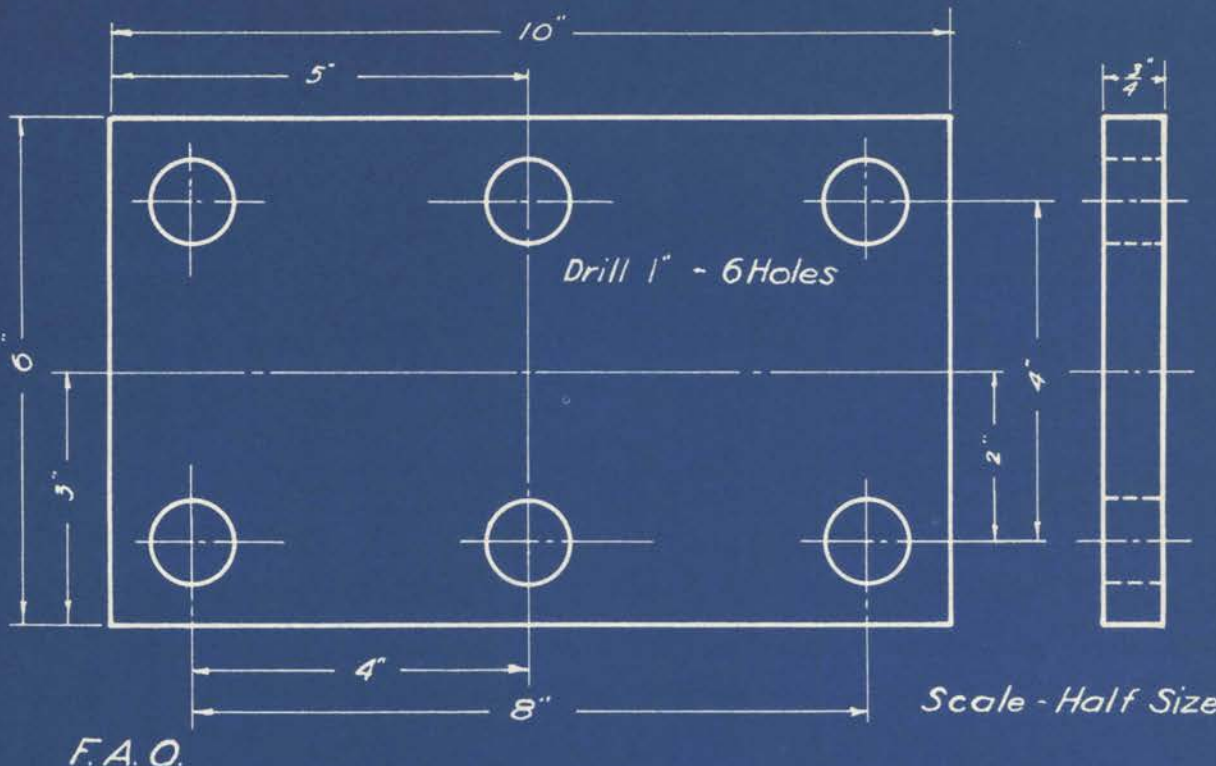
Problem No. 15

Problem 15 is a working drawing for a rectangular steel face plate. The working drawing shows a front and end view. The front view shows that there are six 1" holes drilled in the plate; that these holes are centered 2" on either side of the horizontal center line; that two holes are drilled on the vertical center line and the other holes are centered four inches on either side of the vertical center line. The end view shows that the plate is three-quarters inch thick, and the dotted lines

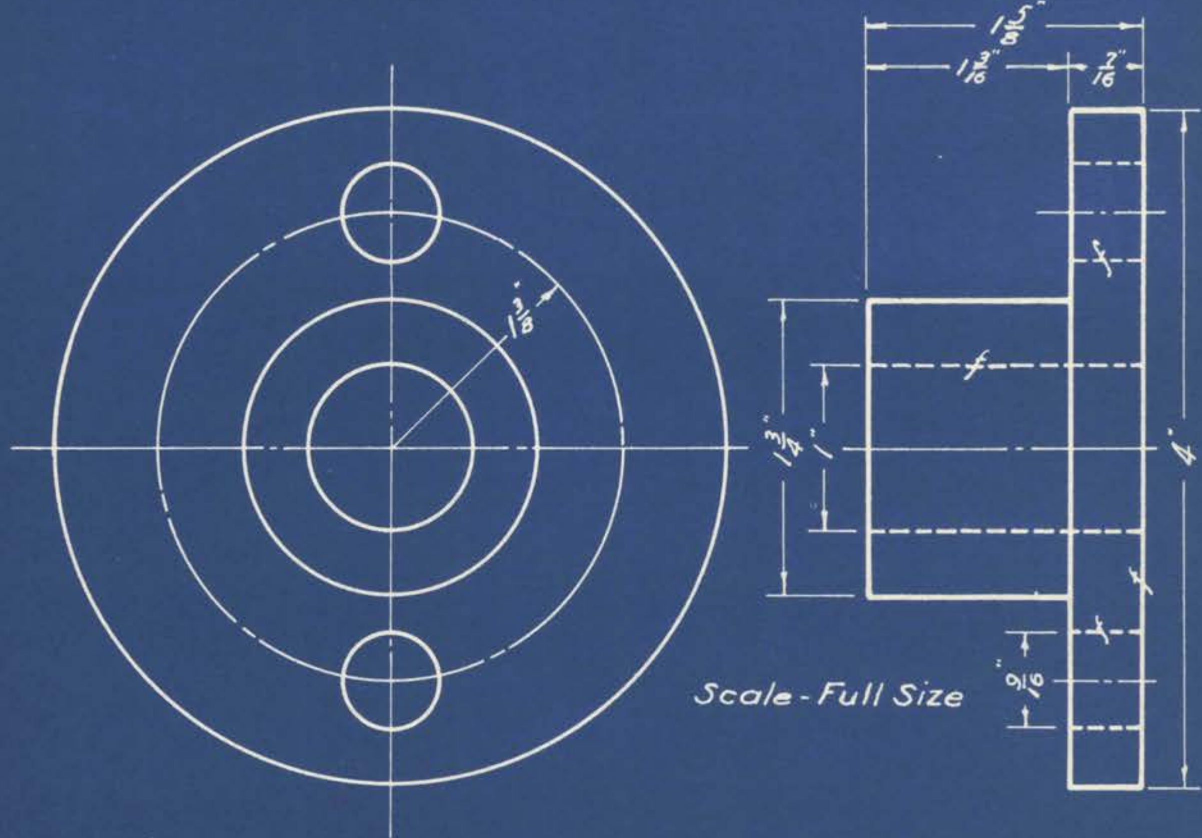


1'-3"
A
SCALE 3-INCHES = 1-FOOT
2'-9½"
B
SCALE 1½ INCHES = 1 FOOT
4'-4¾"
C
SCALE 1 INCH = 1 FOOT
6'-10"
D
SCALE ¾ INCH = 1 FOOT
9'-7½"
E
SCALE ½ INCH = 1 FOOT
20'-6"
F
SCALE ¼ INCH = 1 FOOT
31'-8"
G
SCALE ⅛ INCH = 1 FOOT

FIGURE 10



PROBLEM 15



PROBLEM 16

SYMBOLS

F.A.O.	FINISH ALL OVER	C.I.	CAST IRON
f	FINISH	C.R.S.	COLD ROLLED STEEL
CT BORE	COUNTER BORE	℄	CENTER LINE
R.	RADIUS	O.C.	ON CENTERS
U.S.S.	UNITED STATES STANDARD	P. TAP	PIPE TAP
S.A.E.	SOCIETY OF AUTOMOTIVE ENGINEERS	L.H.	LEFT HAND
O.S.M.	OUTSIDE MEASUREMENT	CSK	COUNTERSUNK
		P.	PITCH
			CAST IRON
			STEEL

Fig. 11

in the end view show that the holes go all the way through the plate.

The student should first study the drawing, read all notes, and form a mental picture of the object. If this is done he will then be able to proceed to answer the questions about the problem.

Questions to be answered about problem No. 15:

1. What is the size of the holes drilled in the plate? ____________
2. Do these holes go all the way through the plate? ____________
3. What is the length of the plate? ____________
4. What is the width of the plate? ____________
5. What is the thickness of the plate? ____________
6. What is the vertical distance between the center lines of the holes? __________
7. What is the horizontal distance between the center of a center hole and the center of either outside hole? ____________
8. What is the distance between the center of the holes and the edge of the plate? ____________
9. What parts of the plate are to be finished? ____________

Problem No. 16

Problem 16 is a working drawing for a packing gland. A pattern is to be made from which a casting is poured. The surfaces marked "f" must be machined reasonably accurately. The two small holes are to be drilled through the casting and the radius of the circle on which they are located is given.

Questions to be answered about Problem No. 16:

1. What is the size of the center hole? ____________
2. What is the length of the center hole? ____________

3. What is the size of the bolt holes? _______________

4. How far are the bolt hole centers from the center of the bore? _______________

5. What is the largest over-all measurement of the gland base? _______________

6. How thick is the base? _______________

7. How many surfaces are to be finished? _______________

8. To what scale was this drawing made? _______________

Problem No. 17

Problem 17 is a working drawing for a bearing. It also is made from a casting and certain parts of it are to be finished while others may be left as the casting comes from the mold. The center of the bearing must be located an exact distance above the bottom of the base. The bolt holes must be located accurately and also must be located by center lines as the outside edges of the casting aren't to be finished and won't be true.

Questions to be answered about Problem No. 17:

1. What are the over-all measurements of the bearing base? _______________

2. How thick is the bearing base? _______________

3. The bearing is for what size shaft? _______________

4. How long is the bearing? _______________

5. How far is center of shaft above bottom of base? _______________

6. How many bolt holes are there? _______________

7. Bolt holes are what size? _______________

8. How are the bolt holes located? _______________

9. How many surfaces are to be finished? _______________

Problem No. 18

Problem 18 is a working drawing for a round cover. It is also a casting and must be machined to fit the end of a pump cylinder. Other parts of the casting may remain as it comes from the mold.

Questions to be answered about problem No. 18:

1. What is the thickness of the rim of the cover? _______________

2. What is the height of the cover over the ribs? _______________

3. How thick are the ribs? _______________

4. What is the diameter of the holes? _______________

5. What is the angle between the holes? _______________

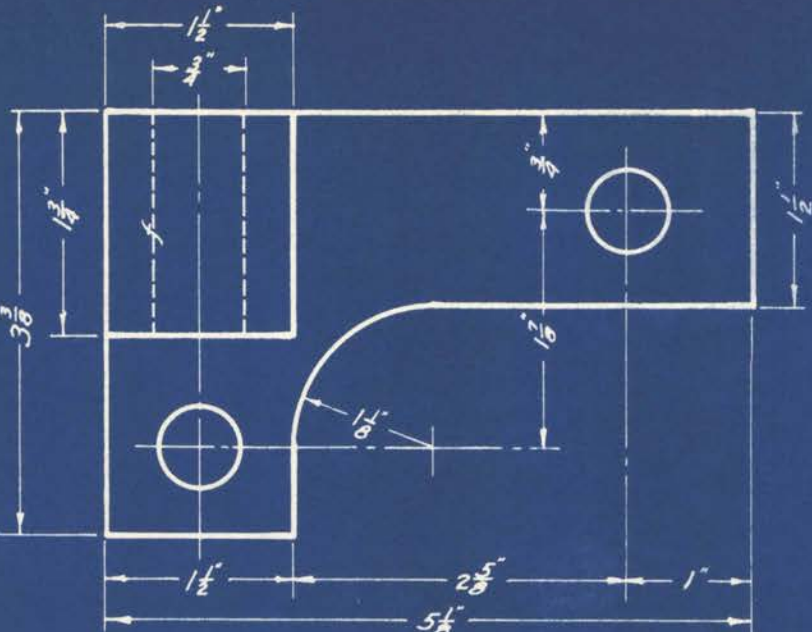
6. How many holes are there? _______________

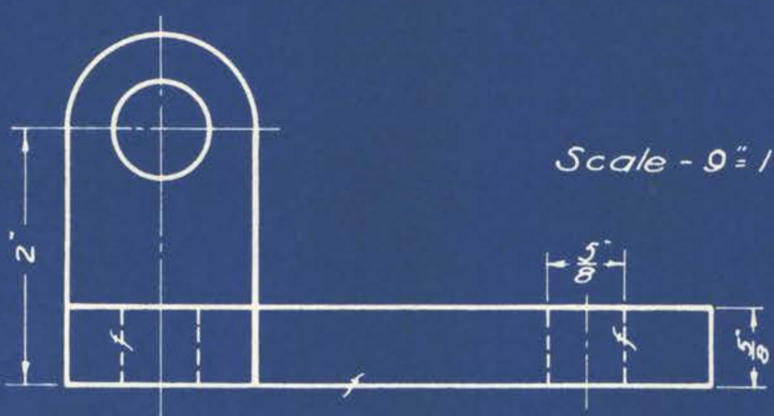
7. What is the size of the spotface? _______________

8. What is the depth of the recess in the bottom of the cover? _______________

9. What is the diameter of the recess? _______________

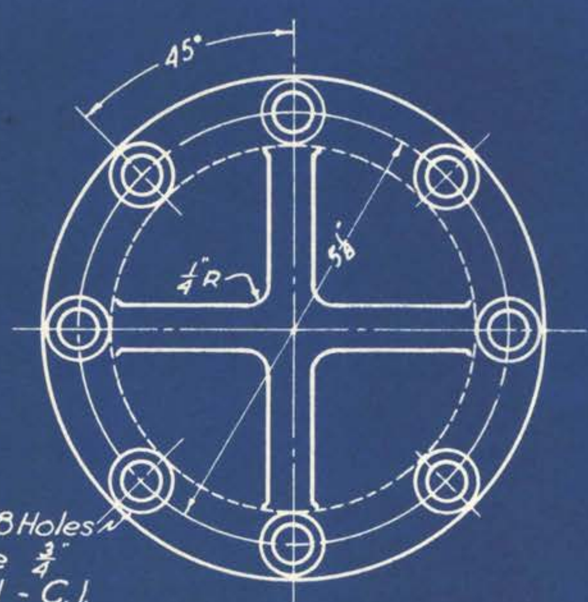
10. What is diameter of the bolt circle? _______________

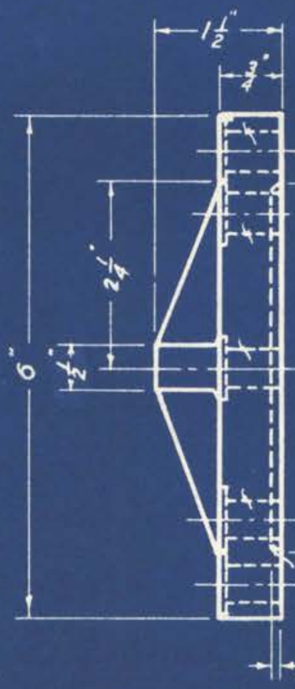




Scale - 9" = 1'-0"

PROBLEM 17

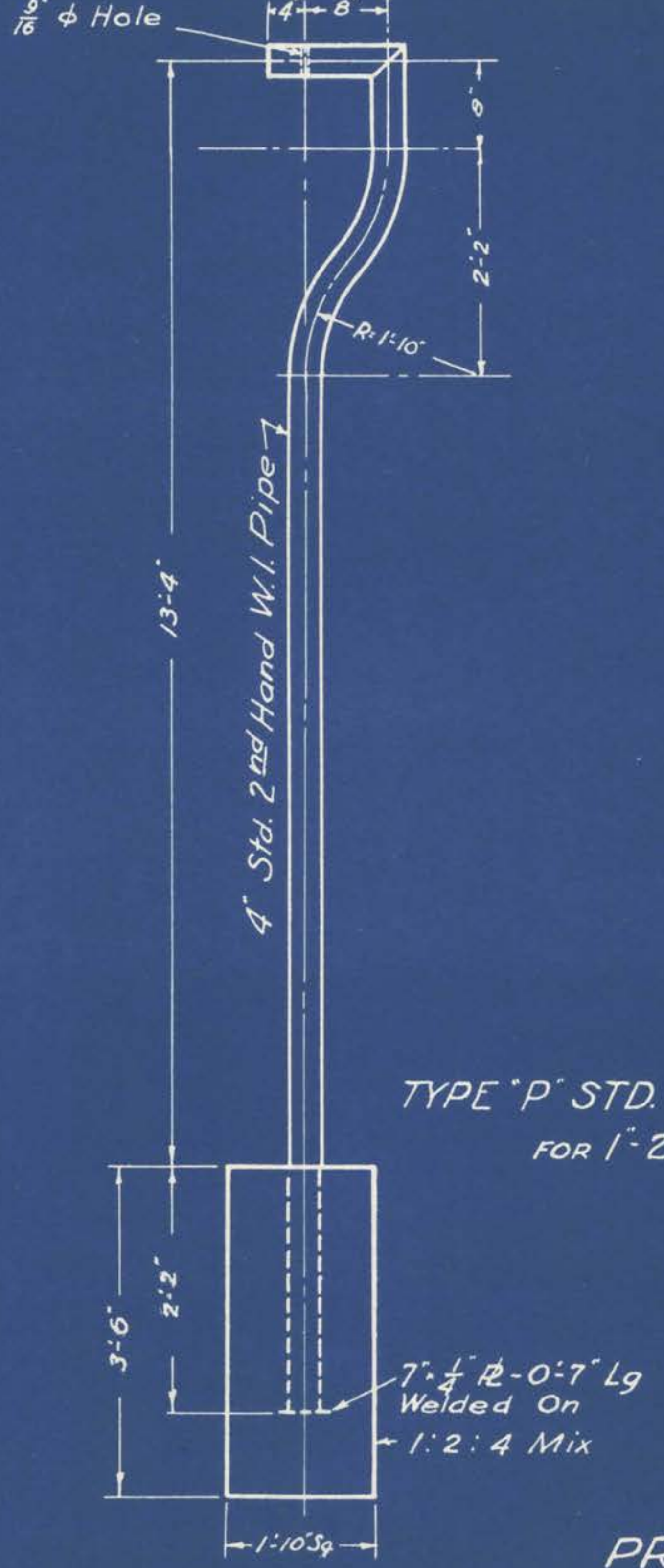




Drill 7/16" - 8 Holes
Spotface ¾"
Material - C.I.

PROBLEM 18

Scale - Half Size



TYPE "P" STD. PIPE SUPPORT
FOR 1"-2" OR 3" LINE

PROBLEM 19

11. What parts of the cover are to be finished? _______________

12. Of what material is the cover made? _______________

13. What is the outside diameter of the cover? _______________

14. How thick is the cover inside the recess, not including the ribs?____________

Problem No. 19

Problem 19 is a working drawing of a standard pipe support. The height of the pipe support may be changed to meet the needs of a particular job, but all other dimensions are to remain the same. It will be noticed that this support is made to carry three sizes of pipe line. There are two symbols used on this drawing which should be noted. The hole drilled through the top end is noted with a symbol which means that it is to be a round hole and the note pointing to the bottom of the pipe uses the symbol for "plate", instead of spelling out the word.

Questions to be answered about Problem No. 19:

1. What is the height of concrete footing? _______________
2. What is width and length of concrete footing? _______________
3. How far does pipe extend into concrete? _______________
4. What mix is used for the footing? _______________
5. What size plate is welded to bottom of pipe? _______________
6. What size hole is drilled through top end of pipe? _______________
7. How far is the center of the hole from the end of the pipe? _______________
8. How much is pipe offset? _______________
9. What is height of horizontal section of pipe above concrete footing?__________
10. What kind of pipe is to be used in making the pipe support? _______________
11. What size lines will this support carry? _______________
12. What is radius of curve in offset? _______________

Problem No. 20

Problem 20 is a working drawing of a gear. The petroleum worker should be familiar with gears as they are used in practically every machine in any industry. Some of the terms used in gear design will be of very little value to the petroleum worker, but if he is not already familiar with the different gear parts it would be well to study Problem 20 for a short time. The diagram at the top of Problem 20 gives the names of the parts of the gear. The working drawing at the lower part of the sheet shows a front and side view of a gear. The gear is designed to fit a certain size shaft as given in the note and the accuracy required for the bore is noted immediately after the diameter of the bore. The machinist who makes this gear knows how much he is allowed to vary from the specified bore, or, in other words, he knows what tolerance is allowed. Such terms as addendum, dedendum and circular pitch are of interest to the experienced machinist and pattern maker.

Questions to be answered about Problem No. 20:

1. What is the outside diameter of the gear? _______________
2. What is the route diameter? _______________

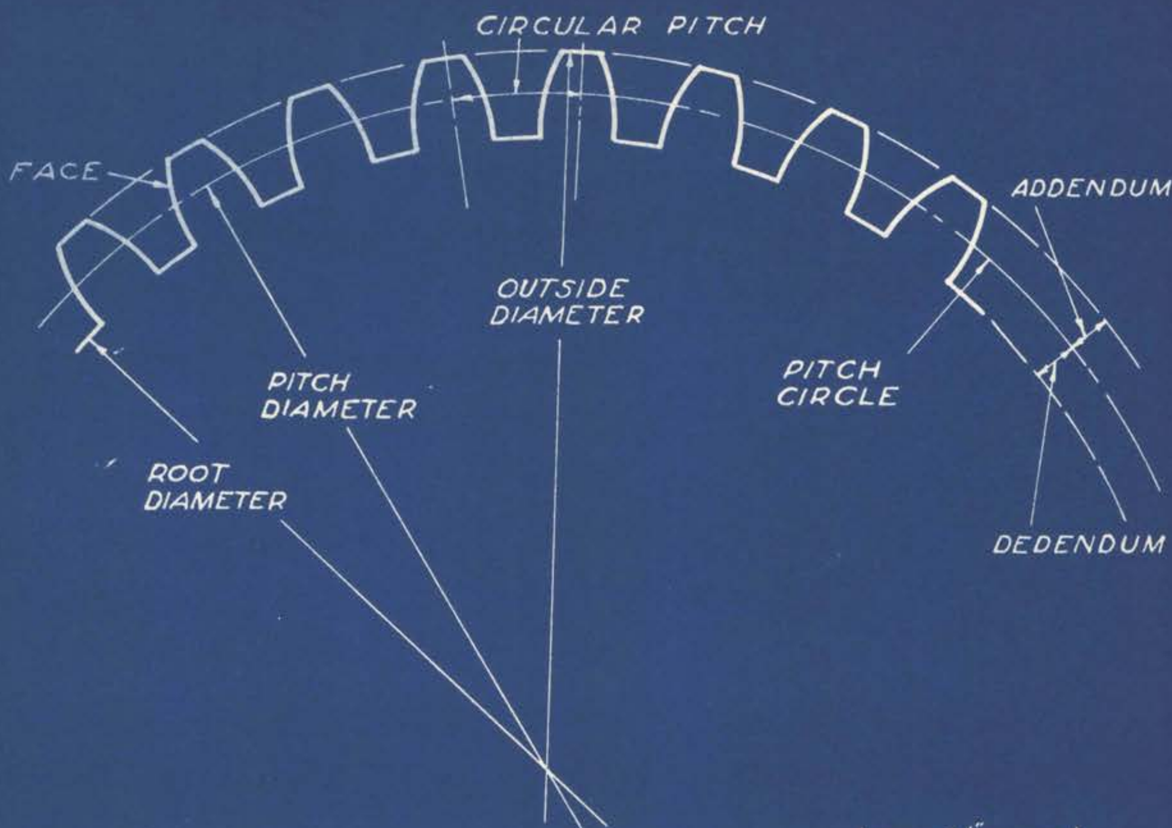
3. What is the diameter of the pitch circle? _______________
4. What is the width of the face of the gear? _______________
5. What is the size of the bore? _______________
6. How much tolerance is allowed? _______________
7. What size keyway is to be cut? _______________
8. What is the diameter of the hub? _______________
9. What is the thickness of the web? _______________
10. What is the addendum (figure this)? _______________

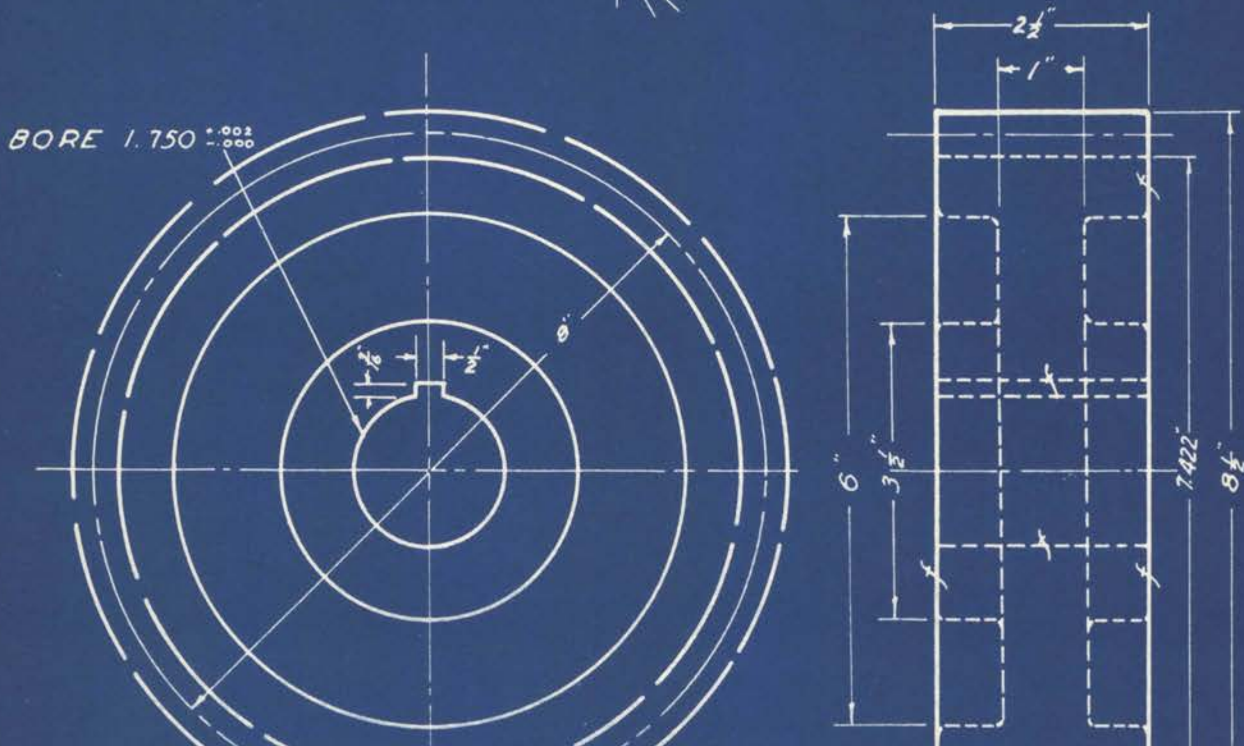
Problem No. 21

Problem 21 is a working drawing for a pipe bracket. The bracket is to be bolted to a wall and a bronze shoe or roller attached to the upper flange so as to provide a support for pipe carrying hot liquids and gases. The roller or shoe allows movement of the pipe due to contraction or expansion as the pipes become hot or are allowed to cool. The slotted holes in the bracket permit adjustment so that the bracket may be raised or lowered in order to straighten the pipe line.

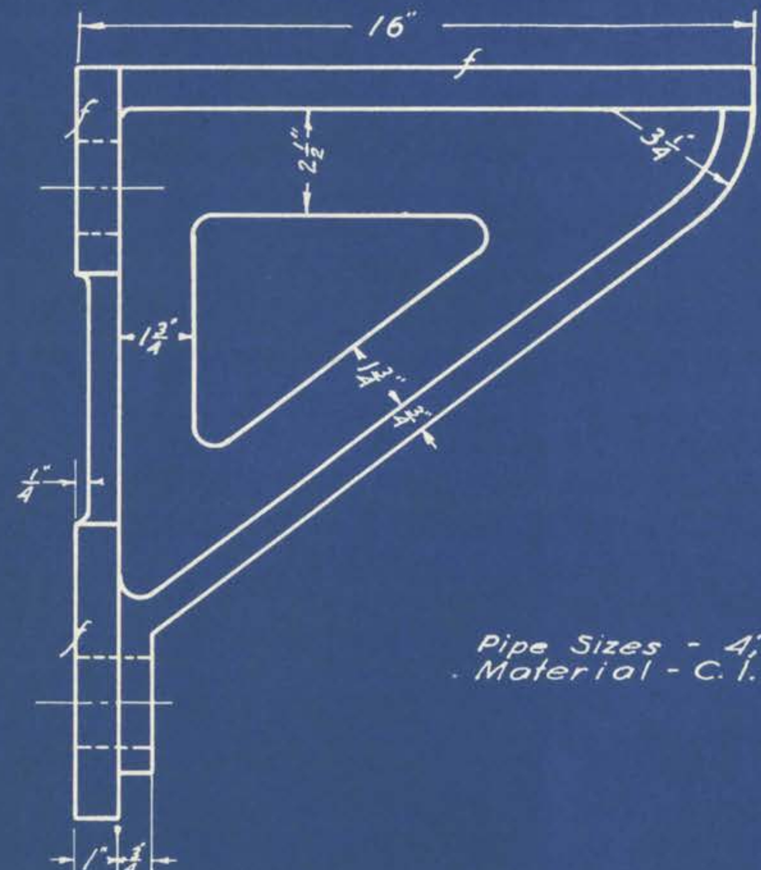
Questions to be answered about Problem No. 21:

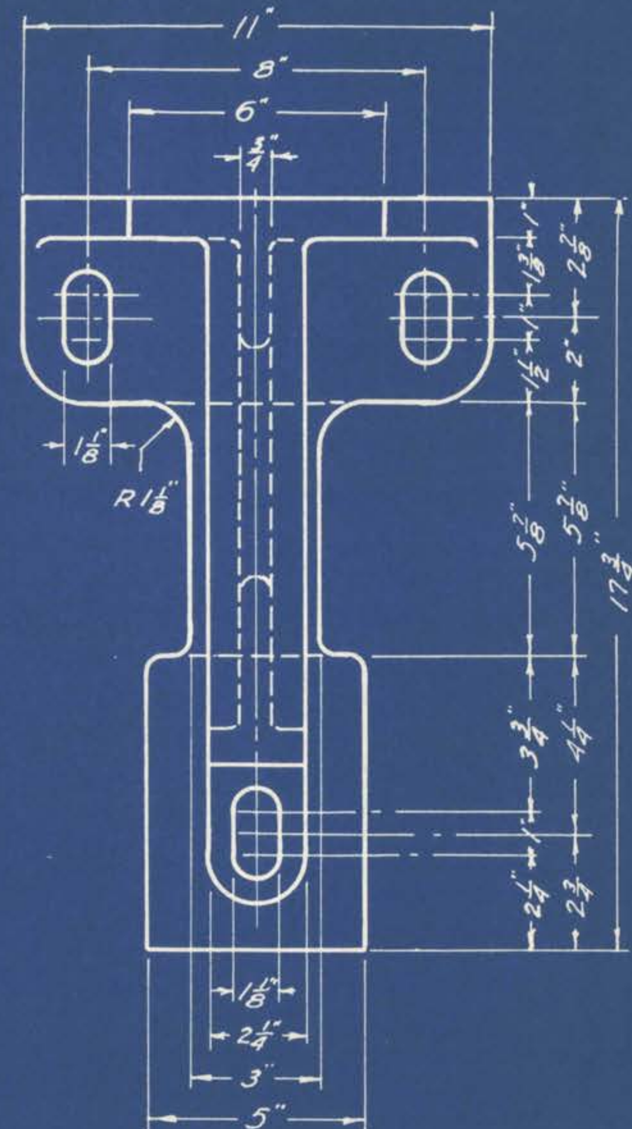
1. The bracket is designed to carry what size pipe? _______________
2. Of what material is the bracket made? _______________
3. What is the width of the slotted holes? _______________
4. What is the length of slotted holes? _______________
5. What is the distance from the top of the bracket to the center of the top slotted hole? _______________
6. What is the distance from the top of the bracket to the center of the lower slotted hole? _______________
7. What is the thickness of the material through which the upper slotted holes are cut? _______________
8. What is the thickness of the material through which the lower slotted hole is cut? _______________
9. What is the thickness of the top flange? _______________
10. What is the width of the top flange? _______________
11. How far does bracket extend out from wall? _______________
12. What is height of the bracket? _______________
13. What is thickness of web reinforcing? _______________
14. What is width of web reinforcing along bottom side of top flange? _____________
15. What is width of web reinforcing along back flange and diagonal flange? _______________
16. What is width of back flange at the top? _______________
17. What is width of lower part of back flange? _______________
18. What is width of middle part of back flange? _______________


CIRCULAR PITCH
FACE
ADDENDUM
OUTSIDE
DIAMETER
PITCH
DIAMETER
PITCH
CIRCLE
ROOT
DIAMETER
DEDENDUM


BORE 1.750 +.002 -.000
8"
2 1/2"
1"
6"
3 1/2"
7.422"
8 1/2"

PROBLEM 20





Pipe Sizes - 4", 5", or 6"
Material - C. I.

PROBLEM 21

19. How thick is back flange at the middle section? ________________

20. How wide is the diagonal flange? ________________

Problem No. 22

Problem 22 is a working drawing for a pair of standard pipe line flanges. The drawing consists of a front view which will apply to either flanges and to sectional views of both flanges. These flanges are Standard Pipe Line and the measurements do not apply to American Hydraulic flanges. They are flanges for three-inch pipe. Note that the two flanges are made in pairs so as to fit together.

Questions to be answered about Problem No. 22:

1. What is the diameter of the bolt circle? ________________
2. What is the diameter of the bolt holes? ________________
3. The holes are spaced how many degrees apart? ________________
4. How many bolts will be required per pair of flanges? ________________
5. What is the outside diameter of the flanges? ________________
6. What is the thickness of the flanges at the points where the bolts go through? ________________
7. How deep is the recess on the face of the right-hand flange? ________________
8. What is the diameter of the recess? ________________
9. How long is the extended part on the other flange which fits in the recess? ________________
10. What is the outside diameter of the extended part? ________________
11. When the two flanges are assembled, how much clearance will there be between the extended part of the left flange and the recess of the right flange? ________________
12. When the two flanges are bolted together, how much space will there be between the two flanges where the bolts are? ________________

Problem No. 23

Problem 23 is a working drawing for a flanged shaft coupling. The two parts are made in pairs so as to fit together. The working drawing consists of an end view and a front view which is in section. The flanges are keyed to the ends of the shafts and then bolted together.

Questions to be answered about Problem No. 23:

1. The coupling is for what size shaft? ________________
2. What size keyway is to be cut? ________________
3. What is diameter of bolt circle? ________________
4. What size holes are to be drilled for the bolts? ________________
5. What is depth of recess in each part of coupling? ________________
6. What is diameter of this recess? ________________
7. What is diameter of hub? ________________

8. What is measurement over both flanges after they are assembled? _______________

9. What is the width of flange of the right-hand piece of the coupling? __________

10. What is the width of flange of the left-hand piece of the coupling? ___________

11. How thick is the flange at the outer edge? _________________

12. At what angle does inner side of flange taper back to web? _________________

13. What is over-all length of the coupling? _________________

14. What is the difference in diameter of the hub at the outer edge and the diameter of the hub next to the web? _________________

15. What is the thickness of the web of each part of the coupling at the points where the bolts go through? _________________

16. How many surfaces are to be finished? _________________

Problem No. 24

Problem 24 is a working drawing for an island to be built in a filling station driveway to receive gasoline pumps, and water and air connections. The great numbers of filling stations that have been built and that are being built have caused more or less standardization of filling station design and accessories. Each oil company decides on a standard design for its own filling stations. Problem 24 is a design for a ten-foot island. The symbol used in giving the sizes of the reinforcing bars should be noticed. This symbol, as has been pointed out before, stands for the word "round", thus, as it is used in this case it indicates that round reinforcing bars are used. If square bars had been used, the circular part of the symbol would have been replaced by a small square.

Questions to be answered about Problem No. 24:

1. What is the width of the island? ________________

2. What is height of the top of the island above the driveway? ________________

3. How thick is the concrete in the island? ________________

4. What concrete mix is to be used? ________________

5. What kind of finish is to be put on the concrete? ________________

6. How far is the lower layer of reinforcing bars to be placed above the bottom of the foundation? ________________

7. How far is the top layer of bars to be placed below the top of the concrete? ________________

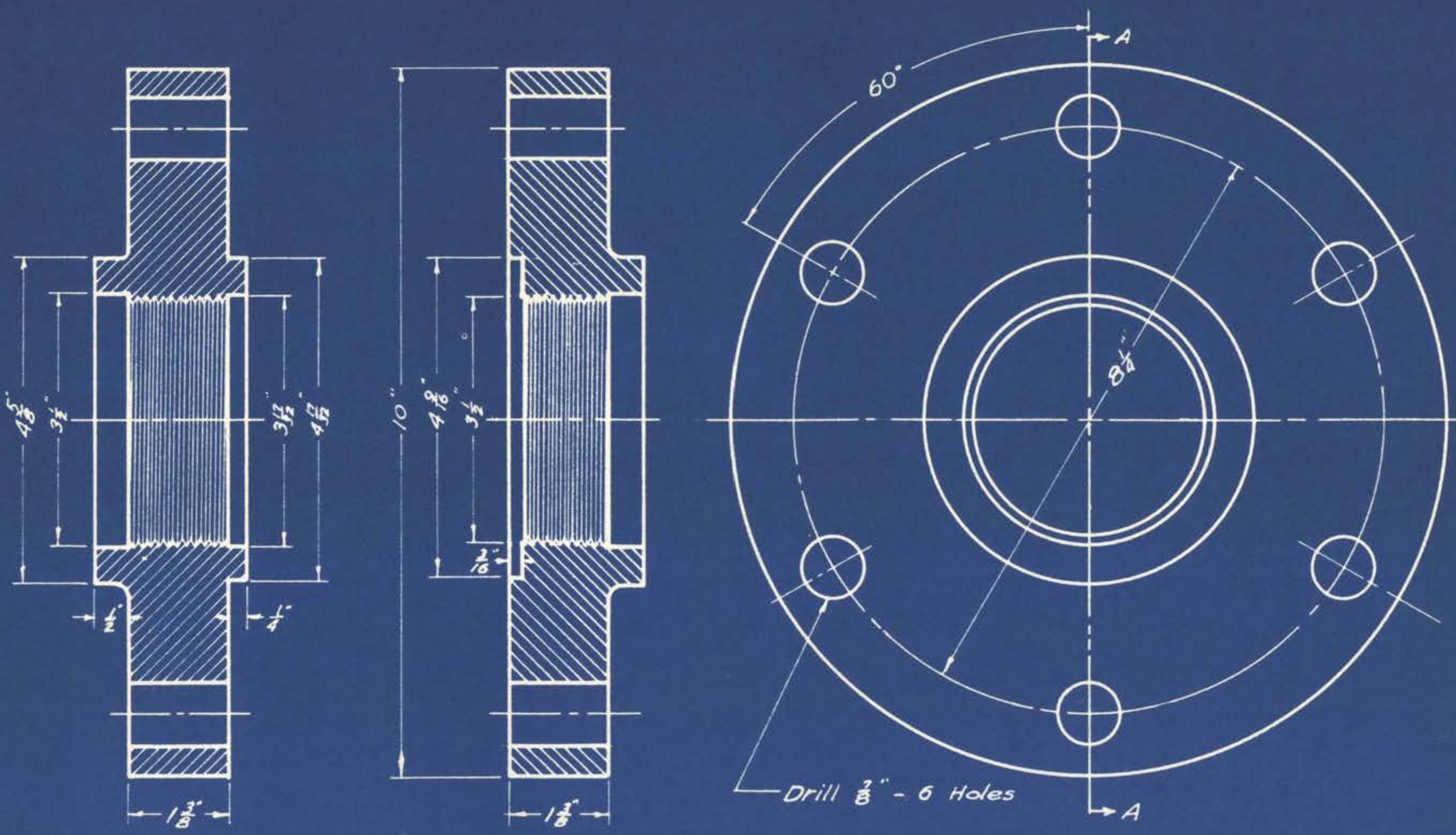
8. How many different lengths of bars are required? ________________

9. Make a list of all reinforcing bars required. ________________

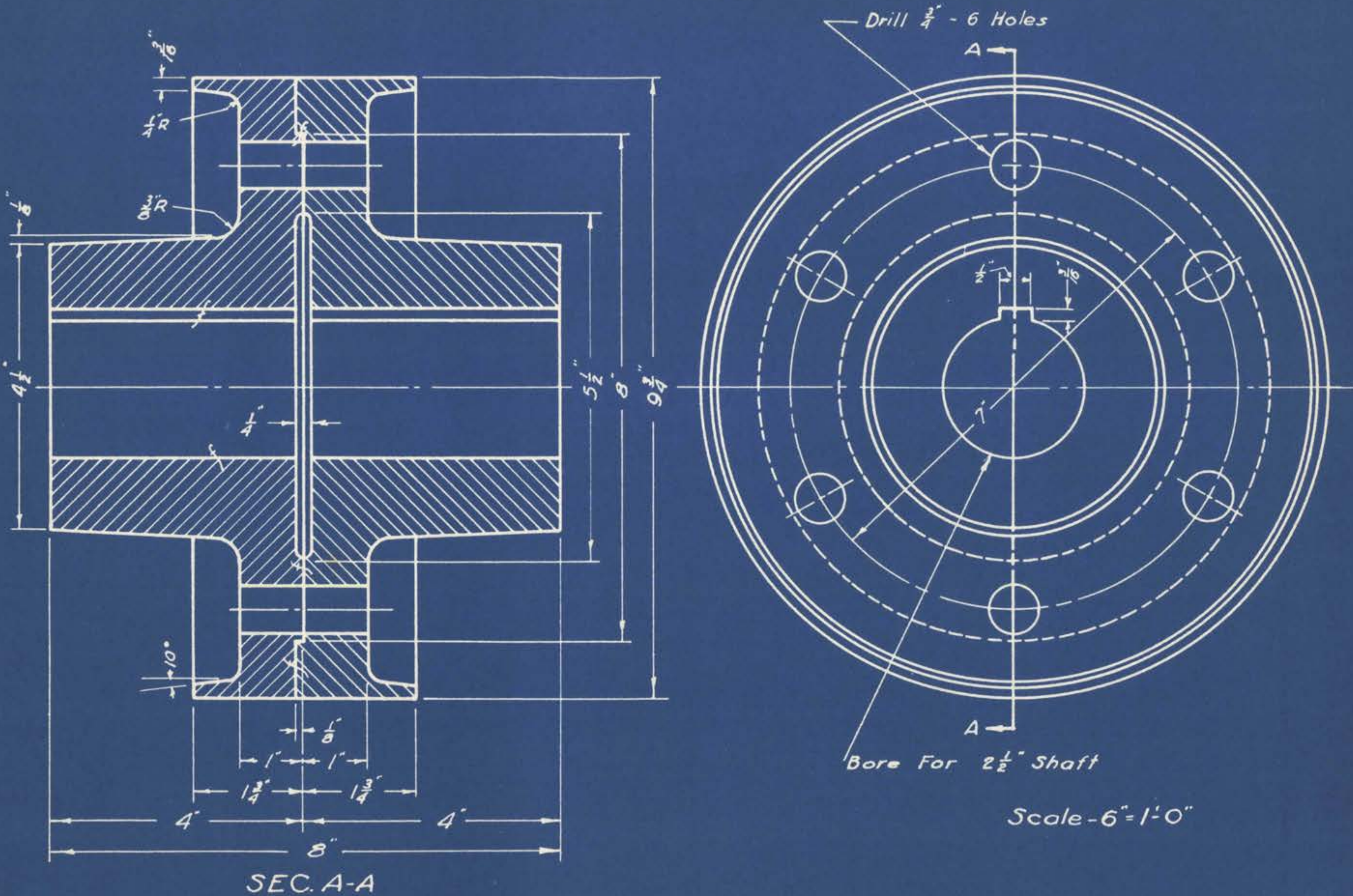
10. What are the sizes of the holes running through the concrete? ________________

11. What is the measurement between these holes center to center? ________________

12. Make a freehand three-view sketch of the island, giving all the information that one would need to actually lay out and build the island.

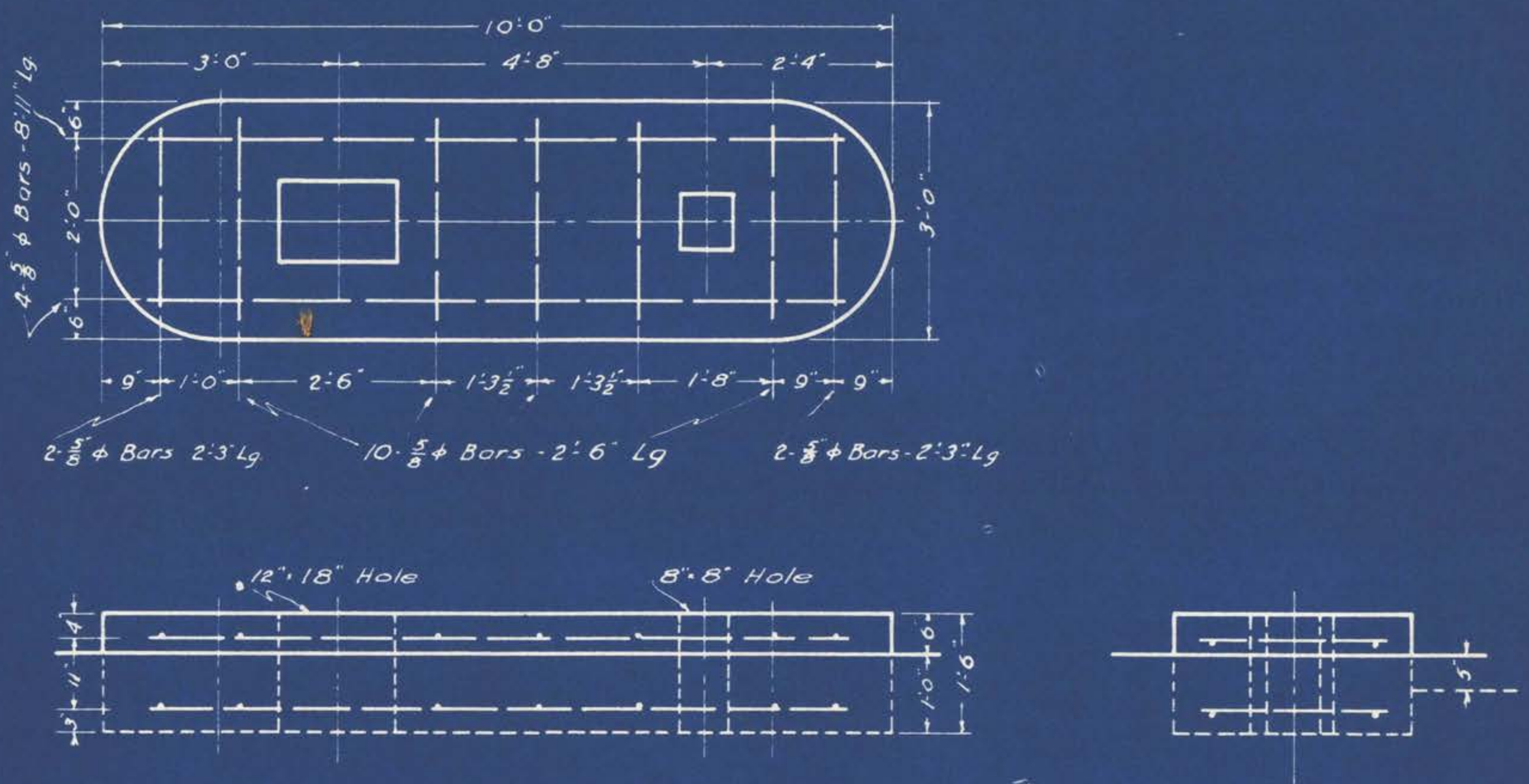

60°
A
A
8 1/4
Drill 7/8" - 6 Holes
10"
4 9/16"
3 1/2
2/16"
1 3/8"
4 5/8"
3 1/2"
3 17/32"
4 17/32"
1/2"
1/4"
1 3/8"

PROBLEM 22



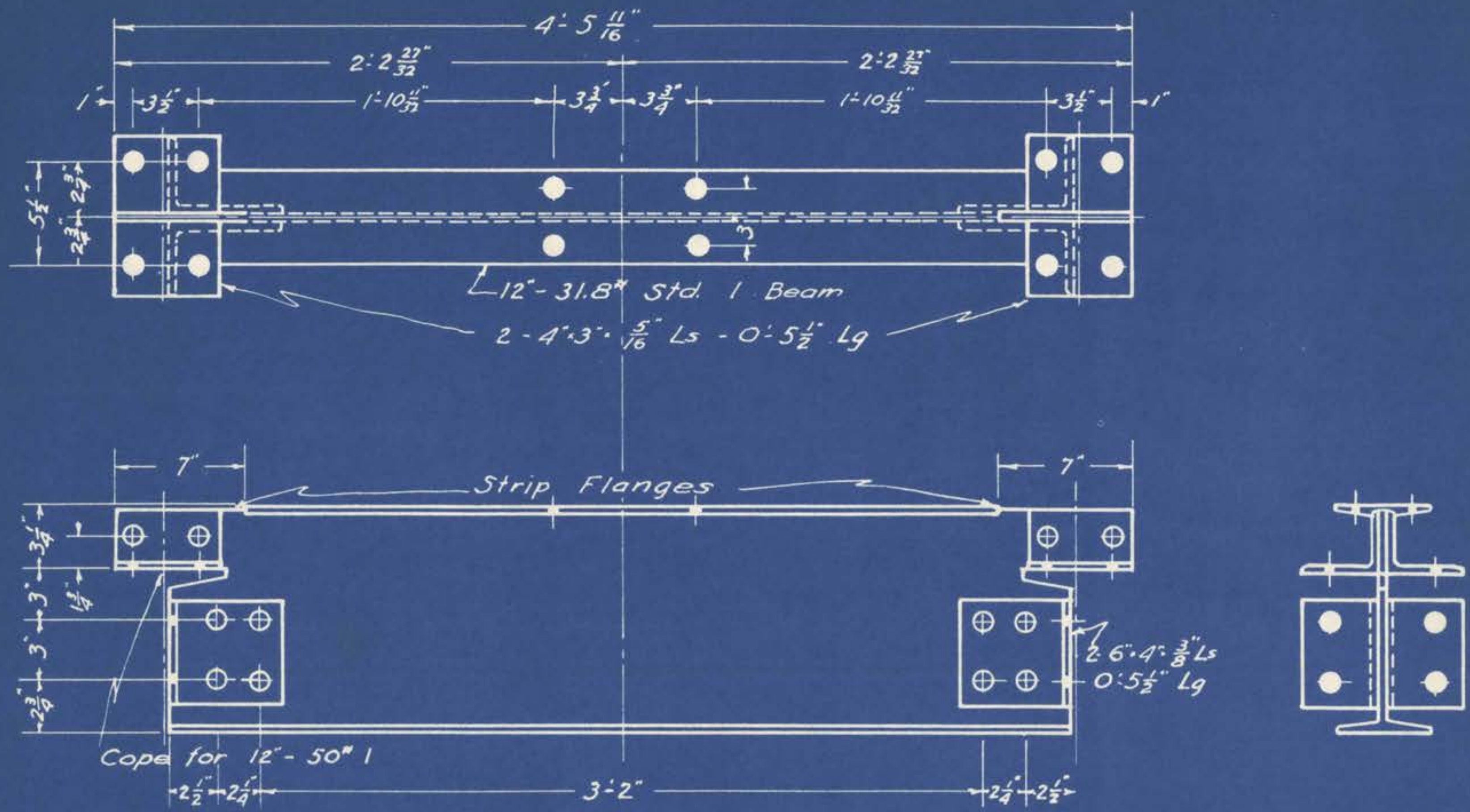
Drill 3/4" - 6 Holes
A
A
Bore For 2 1/2" Shaft
Scale - 6" = 1'-0"
1/4" R
3/8" R
1/8"
4 1/2"
5 1/2"
8"
9 3/4"
1/4"
10°
1/8"
1"
1"
1 3/4"
1 3/4"
4"
4"
8"
7"
SEC. A-A

PROBLEM 23



NOTE: Island to be 1:2:4 Concrete, Finish 1:2 Cement ¾" Thick Troweled Smooth.

PROBLEM 24



NOTE: All Holes 13/16" ϕ
All Rivets 3/4" ϕ

PROBLEM 25

Problem No. 25

Problem 25 is a working drawing for the fabrication of a structural steel crossmember to be used in a Dubbs Still Cleaner. The crossmember is an I-beam and fastened in place by means of angle irons. The symbol for angle iron will be noticed as well as the symbol for round holes as has been pointed out previously. The small circles indicate rivets and the circles which have been filled in with ink represent open holes.

Questions to be answered about Problem No. 25:

1. What length I-beam is required? ________________
2. What is the weight of the I-beam per foot? ________________
3. What is the size of all holes? ________________
4. What size rivets are used? ________________
5. How many holes must be punched in the I-beam? ________________
6. The I-beam is to be coped to fit what size I-beam? ________________
7. How many different sizes of angle irons are required? ________________
8. The wide flange of each of the larger angle irons is fastened to the web of the I-beam with how many rivets? ________________
9. What is the distance center to center between the open holes of the small angle irons measured lengthwise with the beam? ____________
10. What is the distance between the open holes of the small angle irons measured across the I-beam center to center? ________________

Unit II

BUILDING AND PUMP FOUNDATION DRAWINGS

Blueprints used in the petroleum industry are different from those used in many other industries in that a single drawing will contain pipe, structural steel, woodwork, concrete, brick, etc. In most cases, separate drawings are made for every kind of work, if there is enough of the particular type of work to pay for making a separate sheet. In the petroleum industry, much salvage pipe is available and it is used in many cases for structural parts such as columns. For this reason the blueprints which the petroleum worker has need to read will contain almost all types of drawings and symbols.

1. Symbols and Abbreviations:

As has been pointed out before, the draftsman uses many symbols and abbreviations in order to express his ideas and the requirements of a job in the least space possible. Fig. 12 is a sheet of symbols and abbreviations that have been compiled from a study of many blueprints actually used in the petroleum industry. It will be noted that the little rectangular spaces at the top of Fig. 12 are filled in with different kinds of lines. This is known to the draftsman as crosshatching and is the draftsman's means of representing different kinds of material. It will be noticed that brick or stone and cast iron are represented in almost the same way except that the lines representing cast iron are drawn closer together.

The center section of Fig. 12 represents breaks in round solids or pipes and rectangular objects such as timber and the correct representation is shown. The rest of the sheet is composed of symbols and abbreviations that will be found on blueprints. These are just a few of the many symbols and abbreviations that will be found on blueprints, but they are the more common ones, and as the student finds those with which he is not familiar he should make it a point to find out by asking someone who is in a position to know.

2. Notes:

Many times the draftsman will wish to call to the attention of the workman certain facts, and he will do so by making notes on the blueprints. The word "note" is nearly always printed somewhere on the lower part of the sheet and following is the bit of information that the draftsman has in mind. In reading a blueprint, the workman should first study the drawings, trying to form a mental image or picture of the object, and then read every written note on the drawing because many times the information for which he is looking will be found in the form of a note in a very noticeable place.

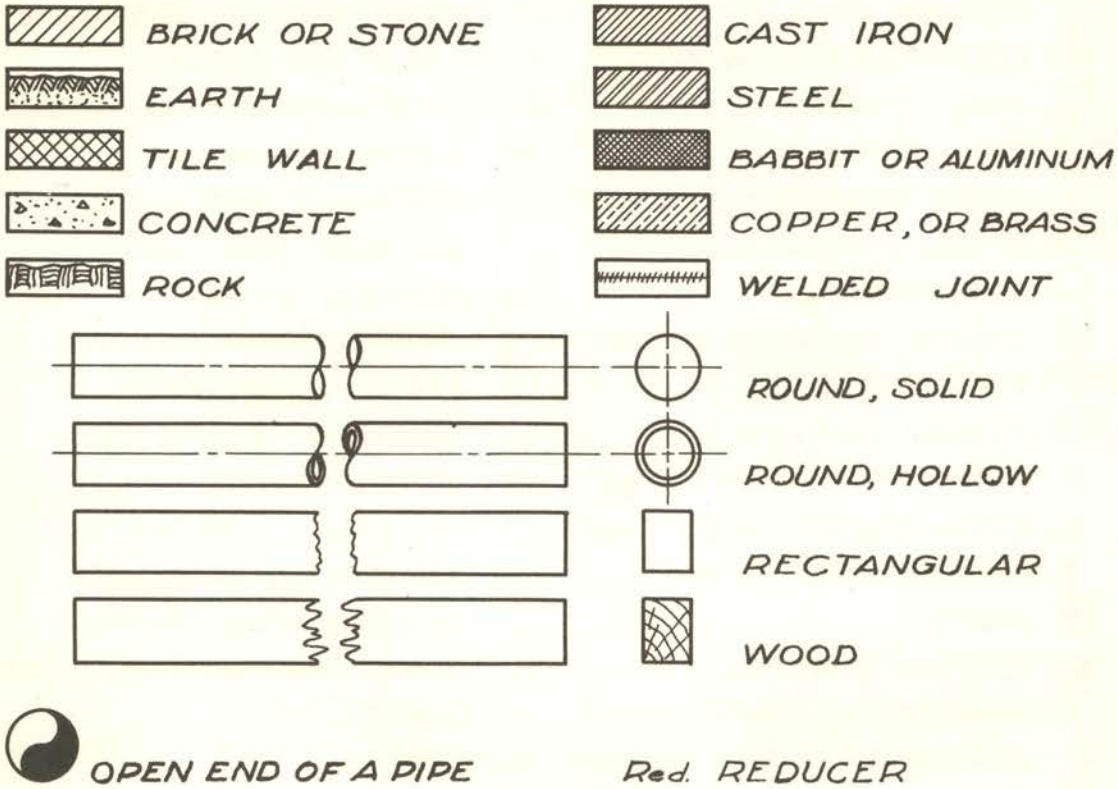
3. Use of Scale on Drawings:

It has been pointed out elsewhere that in the making of blueprints, the blueprint paper must be placed in water. In drying, a large sheet of paper will shrink an eighth to a quarter of an inch so that the workman must use care in scaling missing dimensions. In any case, where a dimension is printed on the blueprint, it is preferred rather than the scaled measurement. Any time that a dimension is omitted the workman should then scale the drawing and determine the correct dimension as accurately as possible.

4. Problems in Reading Foundation Drawings:

The first step in reading a blueprint is to study the drawing and obtain a mental image. All of the blueprints found in the back of this book are exact copies

SYMBOLS AND ABBREVIATIONS



ϕ	ROUND BAR	Red.	REDUCER
⌀	SQUARE BAR	Lg	LONG
℄	CENTER LINE	STD.	STANDARD
[s	CHANNEL IRONS	S.H.	SECOND HAND
Ls	ANGLE IRONS	Ga.	GAGE
PL	PLATE	C.R.	COLD ROLLED
MK	MARK	BtoB	BACK TO BACK
O.C.	ON CENTER	REQ'D	REQUIRED
Ctrs.	CENTERS	W.I.	WROUGHT IRON
O.D.	OUTSIDE DIAMETER	G.I.	GALVANIZED IRON
I.D.	INSIDE DIAMETER	Bz	BRONZE
		@	AT

FIGURE 12

ELECTRICAL SYMBOLS

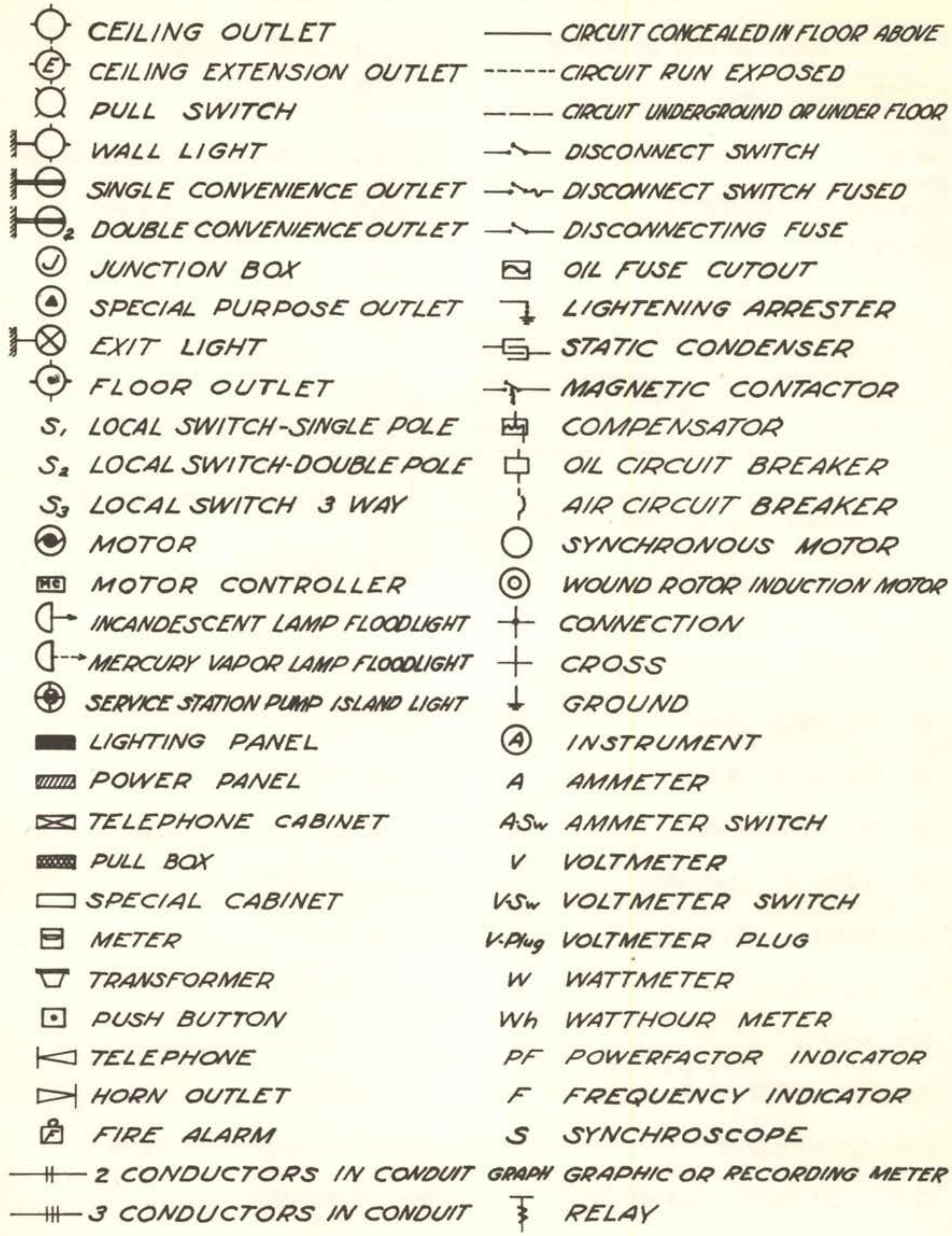


FIGURE 12A

of blueprints drawn by the engineering departments of several large oil companies. Each blueprint has been used by some workman in building or maintaining some part of the equipment in the petroleum industry. These actual drawings have been copied for use in this course rather than assumed problems. It is most likely that the student will recognize one or more of these drawings and be familiar with the job where it was used.

Blueprint No. 101 gives the necessary information to build a new pump foundation and replace a pump. It will be noticed that the drawing in the lower right-hand corner of the sheet is of the foundation and the rest of the sheet is of the piping hook-up. After the student has studied the foundation detail he will be able to answer the following questions on the problem.

Questions to be answered about Sheet No. 101:

1. What is the size of the new pump foundation? ---------------
2. What is the height above floor not including grout rim? ---------------
3. What is the total thickness of concrete? ---------------
4. How many cubic feet of concrete are required for the pump foundation? ---------------
5. How many cubic yards is this? ---------------
6. How many anchor bolts are required? ---------------
7. What length rod is required to make each anchor bolt? ---------------
8. What is the diameter of anchor bolts? ---------------
9. What size sleeves are required? ---------------
10. How much do anchor bolts stick up above concrete? ---------------
11. Bolts are spaced how far apart at liquid end? ---------------
12. Bolts are spaced how far apart at steam end? ---------------
13. What is distance from center line of steam end to center line of liquid end? ---------------
14. How much slope to drain is there allowed? ---------------
15. What is the size of drain pipe? ---------------
16. The foundation detail is drawn to what scale? ---------------
17. The center line of the foundation is how far from the inside of the building? ---------------
18. How far is it from the center line of the foundation to the center line of the other pump? ---------------
19. The center line of the steam end is what distance from the inside of the front wall of the building? ---------------
20. What is the number of the pump being replaced? ---------------
21. Make a freehand isometric drawing of this pump foundation giving all information you would need to do this job.

Sheet No. 102 is a drawing of a foundation for a standard corrugated iron on structural steel frame tool house. Everyone who is working in an oil field or for an oil company will be familiar with this problem. The workman in this case will be required to go on the location with a blueprint similar to sheet No. 102 to lay out and build the forms for the concrete for this foundation. The concrete probably will be poured with all bolts set in the proper place before the tool house is moved to the location. This type tool house is manufactured and hauled in sections to the location where it is assembled. If the foundation is of the proper size and the bolts are located in the proper places the house may be assembled very easily and in a very short time, but carelessness and inaccuracy on the part of the workman can cause bolts to be cut out and new holes to be drilled and new bolts to be placed, or as is more often the case, just leave the bolts out.

The student probably is familiar with this type drawing and should find the following questions very simple.

Questions to be answered about Sheet No. 102:

1. What is size of tool house floor? ________________
2. How thick is floor slab? ________________
3. What is used to reinforce the floor slab? ________________
4. How thick is foundation wall? ________________
5. How far is floor above grade line? ________________
6. How deep is foundation to be carried? ________________
7. What size bolts are used to fasten building to foundation? ________________
8. How many bolts are required to fasten building to foundation? ________________
9. How much of the bolt is threaded? ________________
10. Bolts are set what distance in from outside of foundation? ________________
11. Bolts project how far above the floor? ________________
12. Bolts project how far into concrete? ________________
13. Is bolt spacing the same in the rear and on the sides? ________________
14. Why are the two bolts at the center of the sides spaced 2" apart? ______________
15. What scale is used on plan and section A-A? ________________
16. What scale is used on the elevations? ________________
17. How many cubic yards of concrete are required? ________________
18. What mix is used? ________________
19. What is height of walls above grade? ________________
20. What is over-all height of building above grade? ________________
21. Make a freehand three-view type drawing using a plan or top view and any other views necessary to give all information required.

Sheet No. 103 is a drawing of a foundation for a standard front. It will be noticed that this is a standardized drawing, made for a particular beam, but can easily be made to fit any other length beam by making a few minor adjustments. This problem involves the accurate placing of many bolts. Most of the bolts are provided with sleeves to make the installation of the sampson post and jack post easier. This is a copy of a drawing that was actually used on a recent job.

Questions to be answered about Sheet No. 103:

1. What are the over-all measurements of the foundation for the sampson post and jack post? _______________
2. What are sizes of bars 1 and 2 and in what direction do they run? _______________
3. Give mark, number required, and size of reinforcing bars running crosswise. _______________
4. How far does foundation extend below grade? _______________
5. How far above grade does foundation extend? _______________
6. How thick is grout to be? _______________
7. When is grout to be applied? _______________
8. What is length of 4" drain pipe? _______________
9. What is distance between center line of 4" drain pipe and center line of well? _______________
10. What is meaning of the mark *? _______________
11. What is thickness of wall which receives bolts marked "A"? _______________
12. What is size and length of bar required for each "A" bolt? _______________
13. How far do they project above concrete? _______________
14. What is thickness of walls receiving "B" bolt? _______________
15. What is size and length of bar required for each "B" bolt? _______________
16. Does the long bend or the short bend on the "B" bolt project out of the concrete? _______________
17. How many "B" bolts are required? _______________
18. When shall turnbuckle eyes be placed through "B" bolts? _______________
19. Turnbuckle is for what size lugs? _______________
20. What is size of pipe sleeves? _______________
21. Sleeves are around all bolts except those of what mark? _______________
22. What material is required to make bolt "D"? _______________
23. Where is the reducer to be made? _______________
24. How many "C" bolts are required? _______________
25. What is size and length of bar required for each "C" bolt? _______________
26. How far do all bolts project out of concrete except "A" bolts? _______________
27. How far are lower reinforcing bars above bottom of foundation? _______________
28. In which direction are anchor bolt bends to be turned? _______________
29. How many cubic yards of concrete are required? _______________
30. How many cubic yards of grout are required? _______________

Sheet No. 203 is a detailed drawing of a tank truck loading rack. A number of concrete footings are required. It is necessary for some workmen to go on the job and lay out the foundation. Again accuracy is necessary and this drawing must be studied closely in order that the footings will be in the proper location and everything will fit when the time comes for assembling the parts.

Questions to be answered about sheet No. 203:

1. How many footings are required for the loading rack and steps? _______________
2. What is size of footings for rack? _______________
3. What is size of footing for steps? _______________
4. How far do footings project above grade? _______________
5. What is distance between rack footings running lengthwise? _______________
6. What is distance between rack footings running crosswise? _______________
7. What is distance between step footing and first rack footing? _______________
8. What size bolts and how many in step footing? _______________
9. How many cubic feet of concrete would be required for these footings? _________
10. How many cubic yards will this be? _______________
11. Make a three-view sketch containing sufficient information for a workman to lay out and dig the holes for these footings and build the forms ready for concrete.

Unit III

PIPE DRAWINGS

The petroleum worker will come in contact with many kinds of pipe drawings. Pipe is used in many places and for many purposes in construction work. It is used for the transportation of liquids and gases; it is used for posts and other structural members carrying loads; it is used for hand rails, guard rails, etc., and, due to the fact that great quantities of second-hand pipe are available, it is a construction material which usually receives first consideration.

1. Symbols and Conventions:

Anyone who has installed pipe fittings and valves knows that they are complicated pieces of mechanism. It will readily be seen that it is a waste of time for a draftsman to make a complete working drawing of every gate valve that is to be installed in the field. The draftsman knows what a gate valve is and so does the workman in the field, so a note on a blueprint is all that is necessary to carry the information. This discussion applies as well to all other types of valves and pipe fittings used in the field. In order to simplify the draftsman's work, symbols for pipe fittings have been agreed upon and accepted by engineers and draftsmen.

The symbols of common pipe fittings are shown in Fig. 13. A study of the figure will prove to the student that the symbols are very simple. Each symbol is drawn as easily as possible and to resemble as much as possible the fitting being described. Symbols are given for both screwed and flanged fittings.

2. One-Line and Two-Line Drawings:

A pipe drawing using the two-line system resembles the actual pipe job more than does the one-line system. Fig. 13 has two main headings, single-line and double-line. Each of these is divided into two columns--screwed and flanged fittings. This gives four symbols for each fitting. Take, for example, the first which is a union. The first symbol is the symbol of a screwed union, using the single-line pipe drawing system. The second symbol on the same line is of a flanged union, using the single-line pipe drawing system. The third symbol is of a screwed union, using the double-line pipe system, and it will be noticed that this symbol resembles a screwed union very much. The fourth symbol is of a flanged union, using the double line pipe system, and it will be noticed that this symbol resembles a flanged union. The student will be familiar with most of these fittings and he should study this figure, trying to connect each symbol with the fitting which it represents. If the student can see why each symbol is drawn as it is, the reading of pipe drawings will be much more simple.

3. Three-view and Isometric Drawing:

Three-view pipe drawings are usually rather complicated as will be seen from a study of Sheet No. 101. When pipe drawings become so complicated, it is common practice to make an isometric drawing in order that the lines may be traced and better understood. Many times tanks and pipe lines are already located in the field and it is desired to make changes and additions to the present piping system. In cases of this kind, isometric drawings are made of the present piping system and of the lines and equipment to be added. Such drawings are usually drawn to no scale, the purpose being to give the workman a mental picture of the system as it now stands and of the lines to be added. The actual measurements of the lines to be installed are to be determined in the field. Sheet No. 152 is a drawing of this kind.

4. Taking Information off Pipe Drawings:

The procedure in reading pipe drawings is the same as in reading foundation drawings. The first thing is to study the drawing and try to form a mental image of the object and then read every note, symbol, and detail on the sheet.

Sheet No. 101 is for the replacement of a pump. The suction lines, the discharge lines, and the steam lines are shown. After the student has studied the entire sheet and read all of the notes, he should proceed to answer the following questions.

Questions to be answered about Sheet No. 101:

1. What is size of discharge lines? ----------------
2. What is size of suction lines? ----------------
3. How far is center line of suction line above pump foundation? ----------------
4. What size ell connects suction to pump? ----------------
5. What size ell connects discharge to pump? ----------------
6. How many 4" screw ells are there shown in the suction line to both pumps? ----------------
7. How many tees are there shown in the suction line to both pumps? ----------------
8. How many 3" flanged ells are shown? ----------------
9. What is size of steam line? ----------------
10. What is size of exhaust line? ----------------

Sheet No. 204 is for an outside damper to be installed at a Kellogg still. It will be noticed that pipe has been used on this job for post and braces. The exact length of pipes required are not given and it is necessary for the workmen to note the scale used and figure out the approximate lengths required.

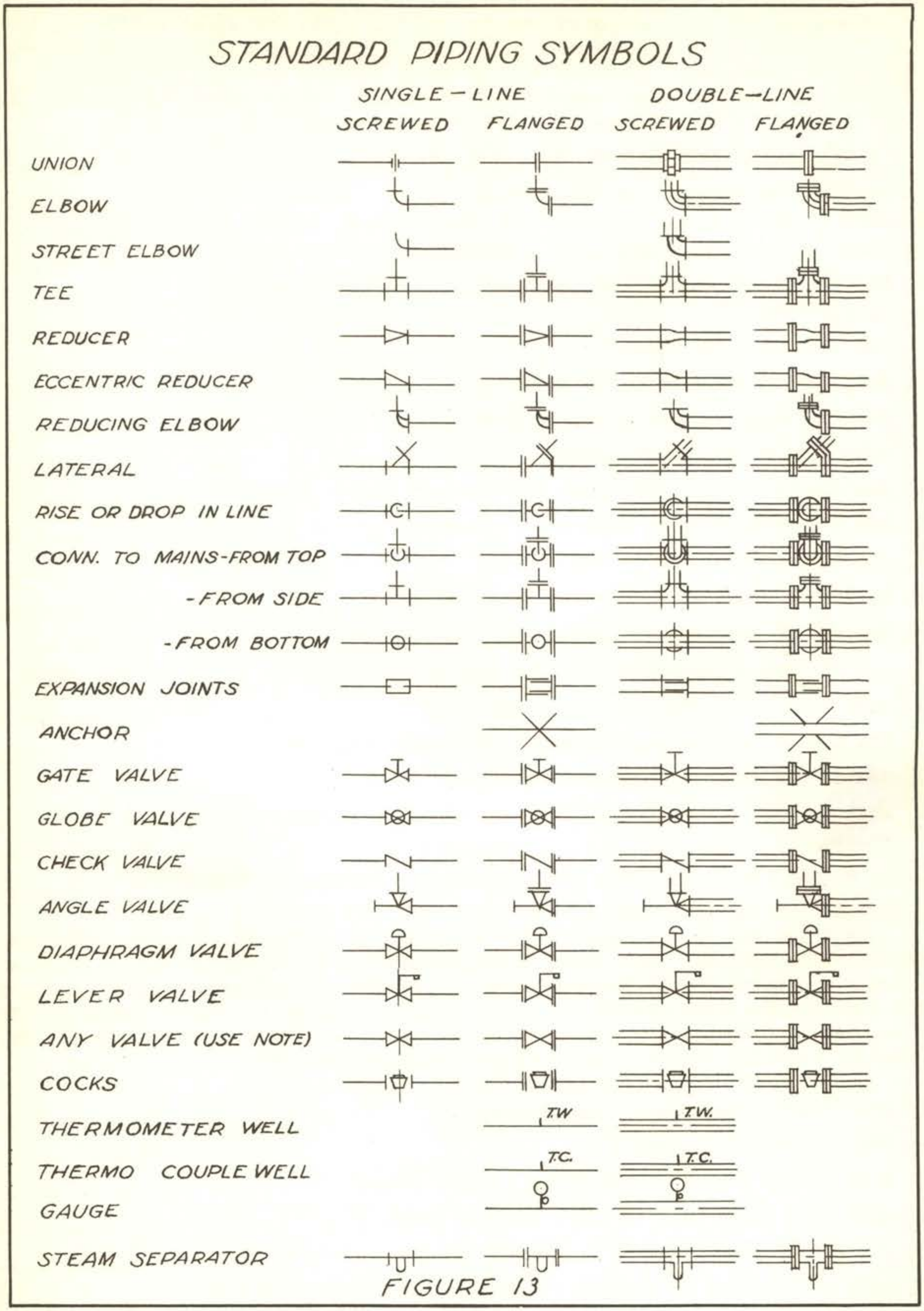
Questions to be answered about Sheet No. 204:

1. What size pipe is used for vertical supports? ----------------
2. About what length are they (scale this)? ----------------
3. What is the kind and size of pipe used for the short braces? ----------------
4. About how long are these? ----------------
5. About how long are the long 2" pipe braces? ----------------

Sheet No. 203 is a working drawing for a tank truck loading rack. Here pipe has been used for a hand railing. Again dimensions have not been given and it will be necessary for the workmen to scale the lengths of pipe required. It will be noticed that the railing is to be welded throughout.

Questions to be answered about Sheet No. 203:

1. What size pipe is used for hand railing? ----------------
2. How is pipe railing fastened to angle irons? ----------------
3. Does the pipe railing go all the way around the loading rack? ----------------
4. What scale is used on this drawing? ----------------
5. About how much 1" pipe is required for the rail? (This will have to be scaled.) ----------------


STANDARD PIPING SYMBOLS
SINGLE – LINE
DOUBLE–LINE
SCREWED
FLANGED
SCREWED
FLANGED
UNION
ELBOW
STREET ELBOW
TEE
REDUCER
ECCENTRIC REDUCER
REDUCING ELBOW
LATERAL
RISE OR DROP IN LINE
CONN. TO MAINS-FROM TOP
-FROM SIDE
-FROM BOTTOM
EXPANSION JOINTS
ANCHOR
GATE VALVE
GLOBE VALVE
CHECK VALVE
ANGLE VALVE
DIAPHRAGM VALVE
LEVER VALVE
ANY VALVE (USE NOTE)
COCKS
THERMOMETER WELL
T.W
T.W.
THERMO COUPLE WELL
T.C.
T.C.
GAUGE
STEAM SEPARATOR
FIGURE 13

Sheet No. 151 is a standard drawing for the installation of lease tank batteries. This particular drawing with minor changes has been used on eight different jobs during three years time and will probably be used on more jobs in the future. This drawing is a two-line isometric pipe drawing. After carefully studying the blueprint, the following questions should be answered.

Questions to be answered about Sheet No. 151:

1. What is the size of the B.S. cleanout? ______________
2. What is the size of the drains in the bottom of tanks? ______________
3. What is the size of pipe line connections to stock tanks? ______________
4. What is the distance from tank bottom to center line of pipe line connection? ______________
5. How far are tanks apart? ______________
6. What size pipe is used for boot? ______________
7. How is sample cock attached to boot? ______________
8. What kind of a cock is used? ______________
9. How many and what size holes are there in baffle plates? ______________
10. How are baffle plates fastened in boot? ______________
11. How is boot fastened to top of tank? ______________
12. Tanks are provided with what size thief hatch? ______________
13. How are 2" openings in top of tanks capped? ______________
14. How far are 2" openings from the edge of the top? ______________
15. What size slots are cut in pipe spreader? ______________
16. How much of end of pipe spreader is covered and how? ______________
17. How is end of pipe spreader supported? ______________
18. What is used for a ladder to get to pressure vacuum relief valve set? ______________
19. If welded tanks are used, how is pressure vacuum relief valve set? ____________
20. How is vertical equalizing line to be held in a vertical position? ____________

Sheet No. 152 is a blueprint for changing and adding to an existing polymerization piping system. This drawing is diagrammatic, which means that it is drawn to no scale and merely shows the position and location of different pieces of equipment and how new lines are to be laid and existing lines are to be changed. It will be noticed that there is a note calling attention to the fact that dotted lines represent existing work and solid lines represent new work.

Questions to be answered about Sheet No. 152:

1. What are the numbers of new poly pumps? ______________
2. How is pump 5A controlled? ______________
3. What is the size of connections to poly pumps? ______________
4. What size lines lead to and from poly pumps? ______________
5. How can present lines be distinguished from new lines? ______________
6. What is the size of present steam line leading to gray tower? ______________

7. What is the I.D. of new gray tower? _______________
8. What is the size of new "steamout" line? _______________
9. What size collars are to be bottom heads of present gray towers? _______________
10. Give size connections to new separator. _______________
11. What is the size of the vent on the new tower? _______________
12. What is the size of relief on #3 tower? _______________
13. What is the size of steam line to #3 tower? _______________
14. What is the size of steam line drain at #3 tower? _______________
15. What kind of check valve is to be placed on "blow down" line? _______________
16. Trace the new steam line to the new gray tower.

Sheet No. 153 is a detailed drawing of a sampson post and jack post. This is a pipe drawing and is also a good example of pipe being used for structural members. This is, also, a copy of a blueprint that is in use at the present time.

Questions to be answered about Sheet No. 153:

1. What sizes of casing are required for the sampson post? _______________
2. What sizes of nipples are required? _______________
3. What size sleeve is required? _______________
4. How many nipples are required for the sampson post? _______________
5. What are the requirements of the 1" round holes to be punched through the channels? _______________
6. What is the size of the plate welded to the channels? _______________
7. How many 2" pipe spacers are required? _______________
8. Make a bill of material for the sampson post. Include everything necessary to complete the job.
9. What is the over-all height of the jack posts? _______________
10. What is the width between center lines of the jack post? _______________
11. What is the width over base plates of the back jack post? _______________
12. What is the width over base plates of the front jack post? _______________
13. What is size of plate shown in detail "G"? _______________
14. How many and what size holes are there in plate detail "G"? _______________
15. What size casing is used in the jack posts? _______________
16. What is the slope of the legs of the jack posts? _______________
17. For what size bolts are the holes cut vertically through the jack post legs? _______________
18. Go to Sheet No. 103 and find the mark for the bolts to go through these vertical holes. _______________
19. Are all plates used in the jack posts the same thickness? _______________
20. Make complete bill of material for both jack posts.

Unit IV

STRUCTURAL STEEL DRAWINGS

The importance of steel to industry cannot be over-stated. Structural steel is the very backbone of industrial enterprise. Structural steel sections make up the thousands of miles of steel rails over which thousands of tank cars of oil are transported each day. Structural steel sections go to make up the bridges over the rivers. Structural steel made possible the $35,000,000 Golden Gate Bridge at San Francisco, California, and so we find structural steel used in the derricks of the production department, in the towers and buildings of the refinery; in the pump stations of the pipe line company; and in every phase of the petroleum industry.

1. Symbols and Conventions:

Most of the symbols and conventions used in structural steel drawings are found in Fig. 12. These will be found to be very closely related to the things which they represent. A study of the symbols in the figure will show that a structural steel plate is indicated by a "P" with an "L" drawn through it. The I-beam is so-called because its section resembles an "I". The symbol for angle iron resembles the capital "L", and this is used because it forms an angle between two lines. The other symbols will be seen to be connected likewise with the structural members which they represent.

2. Abbreviations and Notes:

Many notes are required in order to explain fully the meaning of structural steel drawings. Due to the fact that drawings must be made to small scale in order to get everything on a small sheet of paper, the structural sections are very small and there must be a note by every structural member to give its full description. Notes are used also to indicate the method of assembly, that is to say, that all members should be welded in the field or that all shop work is to be riveted, and field work to be bolted, or whatever method of assembly that is specified by the engineering department. The workman must read all notes or writing on every blueprint because these are as much a part of the drawing as are the lines.

3. Structural Steel Sections:

The most common structural steel section is the angle iron. This is used for frame work and all light structural steel parts where a solid frame work is required but no great load is to be carried. The angle iron is always dimensioned in one particular way. The dimensions are always in the following order: the width of the wider flange by the width of the narrower flange by the thickness and the length. In many cases angle irons are used where the two flanges are the same so the proper method of dimensioning would be a 6" x 4" x ½" ∠, 4' -11" long. The channel iron is used for carrying greater loads than the angle iron, and where an I-beam is not required, channel irons may be used. The I-beam is used for load carrying purposes. The "H" section is used for columns, it being so constructed as to resist bending in either direction. Channel irons, I-beams, and "H" sections are dimensioned by giving the depth of the beam, that is, the distance over the flanges, and the weight of the beam per running foot. A channel iron would then be dimensioned by giving the measurement of the flanges, such as 10", and the weight per running, such as 15#. The strength of these sections depend upon the thickness of the flanges and web, and giving the weight per foot is the method of indicating the thickness of the parts.

4. Practice Taking Information Off Blueprints:

Sheet No. 201 is a blueprint of some simple parts to be used in assembling an agitator and for other purposes. The structural steel used in this blueprint is in light sections and rather simple parts so that the student should easily answer all the questions.

Questions to be answered about Sheet No. 201:

1. Of what material is air filter made? ______________
2. What size angles are used in the frame? ______________
3. What is spacing of stove bolts? ______________
4. How is hardware cloth attached to frame? ______________
5. Make a bill of material for air filter.
6. What is size of agitator support? ______________
7. How many supports are required? ______________
8. Make a bill of material for one agitator support frame.
9. How is agitator fastened to tank? ______________
10. What is diameter of bolt circle on agitator templet? ______________
11. How far is center of agitator above bottom of tank? ______________
12. How many and what size bolts are required to fasten agitator to tank?_________
13. What is horizontal distance between center line of motor and center line of agitator? ______________
14. What is distance from center of motor pulley to center of agitator pulley? ______________
15. How is gauging assembly fastened to top of tank? ______________
16. Of what material is pulley bracket made? ______________
17. What size plate would be required to cut pulley bracket (scale this)?_________
18. What size and pulley is required and of what material? ______________
19. What is used for a weight? ______________
20. Make a bill of material for gauging assembly.

Sheet No. 202 is very similar to Sheet No. 201, being also details for an agitator. Structural steel sections are used here to build a frame which is to support the agitator and driving motor. The method of marking the parts in order to make assembly easier should be noticed.

Questions to be answered about Sheet No. 202:

1. What is mark on motor base assembly? ______________
2. What material is required for motor base assembly? ______________
3. What is requirement of 1 3/16" round holes drilled in channels? ______________
4. What is mark on shaft to fit in these holes? ______________
5. What is length of shaft? ______________

6. Shaft is drilled for what size cotters? _______________

7. What size angles are required for angle bracket? _______________

8. What size plate is welded to angles? _______________

9. How many and what size holes are drilled in angles? _______________

10. What is length of pipe spacer? _______________

11. How is the tex-rope drive tightened? _______________

12. What size angles are used for legs on the frame supporting the agitator and motor? _______________

13. How are the legs fastened to the floor? _______________

14. What size angles run around the top of the frame? _______________

15. How are the angles fastened to the tank? _______________

16. What size plate is used to cover the frame? _______________

17. What is distance between the agitator center line and motor center line? _______________

18. What is O.D. of 3/4" ring to be welded to tank? _______________

19. What is B.C. (bolt circle) diameter? _______________

20. What is I.D. of the ring? _______________

Sheet No. 203 is a detail of a tank truck loading rack. Here structural steel has been used to build a platform and steps. This type of drawing is very common in the petroleum industry in the design and fabrication of the many tank walks found in the field. The student has previously studied this sheet, but he should again study closely the manner in which the floor is put together and then proceed to answer the questions.

Questions to be answered about Sheet No. 203:

1. What kind of grating is required for floor of rack? _______________

2. Give dimensions of angles used for legs. _______________

3. How far do the legs extend into the concrete (figure this)? _______________

4. What size U bolts are required to clamp pipe risers to rack? _______________

5. How many risers are there? _______________

6. What is required for the stair horses? _______________

7. What kind of stair treads are required? _______________

8. How are treads fastened to risers? _______________

9. What is height of stair risers? _______________

10. What is the note concerning the angle across the platform at the head of the steps? _______________

11. Make a bill of material for the structural steel required for this job. Do not include pipe railing.

The student has previously studied Sheet No. 204. Special notice should be given the details and notes on this blueprint.

Questions to be answered about Sheet No. 204:

1. What are dimensions of angles forming the beam for the winch line? ____________
2. What is space between the backs of these angles? ____________
3. What size U bolts are required to fasten winch? ____________
4. What size plate is required for winch? ____________
5. How are measurements for holes in the plate to fasten the winch to be obtained? ____________
6. What size rope is required for winch? ____________
7. How many sheaves are required? ____________
8. What is over-all length of shaft for sheaves? ____________
9. How many threads per inch on the shaft? ____________
10. What is used for bearings for the shaft? ____________
11. How are sheave brackets fastened to the angles? ____________
12. What is length of the two fahrite beams? ____________
13. What size rod is used for anchors on back of fahrite beams? ____________
14. What is length of the two new lintels required? ____________
15. How far are they apart B. to B.? ____________
16. What is width of damper door? ____________
17. How thick is damper door? ____________
18. How high is damper door (scale this)? ____________
19. How far is center line of damper in front of center line of stack? ____________
20. What is size of plates on bottom of long 45° pipe braces and how are they fastened to top of duct? ____________

Sheet No. 205 is a blueprint of the structural steel for a gray tower, support, platforms, ladders, chutes, etc. Pipe columns, I-beams, channel irons, angle irons and flats are used in the construction of this job. This blueprint is typical of structural steel works. The isometric drawings are valuable in helping the student form a mental picture of what is shown in the front view or elevation and the top view or plan. The student should study this blueprint thoroughly before attempting to answer the questions. This is the procedure in reading many blueprints.

Questions to be answered about Sheet No. 205:

1. What is length of 6" pipe columns? ____________
2. What are dimensions of plates welded to top of columns? ____________
3. What are dimensions of plates welded to bottom of columns? ____________
4. What are dimensions of long I-beams? ____________
5. What are dimensions of short I-beams? ____________
6. What size angles are used to fasten the I-beams together? ____________
7. How many of these angles are required? ____________

8. What size pipe is davit made of? ______________

9. What size pipe is 45° brace on davit? ______________

10. Give dimensions of the two pieces used in making the lower step bearing for davit. ______________

11. What size hole is drilled for the upper guide bearing of davit? ______________

12. To what is this bearing attached and how? ______________

13. What is length of vertical angles supporting the hand rail of the upper platform? ______________

14. What are dimensions of upright angles for top ladder? ______________

15. What is spacing of ladder rungs? ______________

16. What size bars are used for rungs? ______________

17. What size flats are used for hoops on upper chute? ______________

18. What material is to be used for lower chute? ______________

19. What are dimensions of angles used for floor beams on lower platform? ______________

20. What is to be used to floor lower platform? ______________

21. What is distance from ground to lower platform? ______________

22. What is the distance from lower platform floor to upper platform floor? ______________

23. What is height of center line of horizontal davit pipe above ground (figure this)? ______________

24. How is lower platform supported? ______________

25. How is upper platform supported? ______________

26. What is size of concrete columns to be poured around the pipe columns? ______________

27. What is the size of concrete beams to be poured around the I-beams? ______________

28. What is the purpose of the concrete? ______________

29. What size pipe is used to brace the 6" pipe columns? ______________

30. What is the length of these braces (scale this)? ______________

Unit V

PIPE LINE DRAWINGS

The student has seen that blueprints are very much the same regardless of the company or type of work. Some of the large prints in the back of this book are taken from blueprints actually drawn for use in the refinery, some for use in production work, and others for use in pipe line work. The pipe line drawings necessarily involve much pipe work, but so do refinery and gasoline plant drawings. However, drawings for long pipe lines running from city to city are only used by pipe line workers.

Due to the many types and kinds of valves and gates, etc., it will be noticed that the kind of gate is usually given by note. Just to say gate valve isn't sufficient as strength and quality of material also must be considered. Similarly, to say six-inch pipe isn't sufficient and other description is, therefore, necessary to describe completely the material needed. In the following blueprints, it will, therefore, be noticed that the symbols are used but are frequently explained by notes.

Sheet No. 251 is a blueprint showing the plot plans of two typical pipe line station cottages. This drawing would be no different if these cottages were being built in a refinery camp. The blueprint, then, is a layout plan for two different cottages showing the location of the house on the building site, the driveway, sidewalks, sewage disposal system, etc. Due to the fact that this is only a layout, a very small scale has been used, the scale being 1" = 20' -0".

Questions to be answered about Sheet No. 251:

1. What are the dimensions of the cottage at station No. 9B? _______________
2. What is the size of plot of ground? _______________
3. What is the width of the driveway? _______________
4. How much crown does the driveway have? _______________
5. How far is front fence set back from center line of county road? _______________
6. How far is septic tank from house? _______________
7. What size soil pipes run from the house to the septic tank? _______________
8. What size line leads away from septic tank? _______________
9. What is the size of the laterals? _______________
10. What is the spacing of the lateral connections in the main line, center to center? _______________
11. About how many feet of four-inch laterals are required (scale this and note the scale used)? _______________
12. What is size of garage? _______________
13. How far is garage set back of the house? _______________
14. What is the size of the breathing pits? _______________
15. How much gravel is laid below the drain tile? _______________
16. What is size of cottage at station No. 15A? _______________

17. What kind of septic tank is required? ---------------

18. How far is the first lateral "Y" branch back of the garage (figure this)? ---------------

19. How many four-inch lines run into the septic tank? ---------------

20. How many four-inch lines are run around the tank and open directly into the six-inch line? ---------------

Sheet No. 252 is a layout plan for a pump station. The details along the right-hand side of the sheet have no connection with this particular sheet but are connected with Sheet No. 253. Sheet No. 252 shows the arrangement of the buildings, driveway, walks, tanks, etc. Other drawings must accompany this blueprint for the actual construction of the station.

Questions to be answered about Sheet No. 252:

1. What are the over-all dimensions of the pump house? ---------------
2. What size are suction lines? ---------------
3. What size are discharge lines? ---------------
4. What is width of gravel drive? ---------------
5. What is size of boiler house? ---------------
6. How far is the first pipe support from the boiler house? ---------------
7. How far apart are the two pipe supports? ---------------
8. What is the distance from the center line of the boiler stack to the boiler stack anchors? ---------------
9. How far is water well from cooling tower? ---------------
10. Is it required that the water well be placed here? ---------------
11. How far is the center line of 1600 barrel water tank from the center line of the cooling tower (figure this)? ---------------
12. How far is center line of 100 barrel fuel tank from center line of cooling tower and hot well (figure this)? ---------------
13. How many exhaust stacks are there? ---------------
14. How far are exhaust stacks away from the pump house? ---------------
15. What is the capacity of the underground gasoline drain tank? ---------------

Sheet No. 253 is a plan of a present manifold showing a new incoming pipe line. The new line is the one along the upper side of the pit. The sectional elevation on this sheet should be thoroughly studied as it shows only the new pipe line and will also simplify what at first glance seems to be a meaningless mass of lines. Each section of pipe on the incoming stream is taken off by itself and detailed. These details of the section are found along the bottom of the sheet and along the right side of Sheet No. 252. The following questions call attention to just a few of the many things that could be mentioned about this sheet and the student can well afford to spend considerable time tracing the pipe lines in this manifold and trying to understand just how they go together.

Questions to be answered about Sheet No. 253:

1. What is size of new incoming line? ________________
2. What is size of concrete anchor? ________________
3. How much concrete will be required for the anchor? ________________
4. What is size of new line to slop tank? ________________
5. What size lines lead out to St. Paul and Chicago? ________________
6. What is size of suction lines running to pump house? ________________
7. How many suction lines are there? ________________
8. What are inside dimensions of manifold pit? ________________
9. What is size of new cross-over connection? ________________
10. Cross-over supports rest on what size lines? ________________
11. What size pipe is used for supports for the cross-over? ________________
12. What is length of piece marked "A"? ________________
13. What kind of pipe is required? ________________
14. What is length of piece marked "B"? (See Sheet No. 252.) ________________
15. What is length of piece marked "C"? ________________
16. What is thickness of plates used to reinforce the "Y" branch connection? ________________
17. What is size of the line branching off? ________________
18. What is the size of the collar welded in the top side of the eight-inch line? ________________
19. What is over-all length of the piece marked "D"? ________________
20. What is size of sample connection lines? ________________

Sheet No. 254 is a cross-section through a pump house. It will be noticed that there are two separate rooms, one for the engines and the other for the pumps. There is a 12½" brick wall built between the two rooms, the purpose of which is fire prevention. The blueprint shows the driving engine, the pump, the sections through the windows, a section through the roof, the traveling cranes, and everything as it would be seen if the front wall of the building had been removed and a picture taken looking directly into the building. This type of blueprint is very important in giving the workmen a little better picture of how the different parts are to be assembled.

Questions to be answered about Sheet No. 254:

1. What is inside width of engine room? ________________
2. What is center to center spacing on the two I-beams supporting the traveling crane? ________________
3. What kind of engine is required? ________________
4. What is size of engine exhaust? ________________
5. What is size of air intake line? ________________
6. What is size of outgoing water line? ________________

7. What is size of starting air line? ________________

8. What is distance between center line of engine out-board bearing and pump O.B. bearing? ________________

9. How thick is the expansion joint between the engine foundation and the concrete floor? ________________

10. What is distance between the floor and shaft center line? ________________

11. What kind of pump is required? ________________

12. What is diameter of shaft in pump room? ________________

13. Why is a 12½" masonry wall necessary between engine room and pump room? ________________

14. What is the distance between pump center line and middle wall? ________________

15. How thick is floor slab? ________________

16. What are the dimensions of the I-beam spanning the pump room? ________________

17. What kind of roofing is specified? ________________

18. What kind of flashing is used? ________________

19. What size ventilator is required for pump room? ________________

20. What is distance from floor to bottom side of roof beam in pump room? ________________

Sheet No. 255 is a type of blueprint that is found only in the production department of the petroleum industry. Similar blueprints are found in the work of gas companies, telephone companies, power companies, telegraph companies, etc. A map of a small section of Tulsa County, Oklahoma, is shown at the top of the sheet and the route of a new pipe line is shown. Each little circle along the pipe line indicates a change of direction in the pipe line. It will be noticed that the pipe line starts at West Tulsa Station No. 20 and continues westward. The small printed notes give the direction of the line and the distance. For example, the starting point of the line is at "0 + 00" and is noted as being the center of field manifold. The next note is "N 64° 02' W", which means that the line is running 64° and 02 minutes West of North. The next note is "1 + 37.8". The one means a hundred feet so that the note means 37.8' more than one hundred. The civil engineer refers to this point as being Station No. 1 + 37.8, which means that the point is 137.8 feet from the beginning point. The next note is "N 45° 52' W" and the following note is "1 - 48.5", which means that there is a section of pipe 10.7 feet long running between these two points and its direction is 45° and 52 minutes West of North. These notes may be traced all the way across the sheet and the exact length and direction of each section can be read. It will be noticed that this particular line lies in two townships and there is a note on the blueprint indicating the line between the two townships.

The drawing at the bottom of Sheet No. 255 is known as a profile drawing, that is, it gives the shape of the pipe line, whether it is running up hill or down hill, or crossing a river. A much smaller scale is used, the irregular line being the actual surface of the ground from the Tulsa Station No. 20 to the Arkansas River following the route of the pipe line all of the way. The profile of the pipe line route looks as if the line may be going over a mountain, but this is not true because the vertical scale is in feet, each small space being ten feet and the horizontal measurements being eight spaces per mile, or 660 feet per space. If the same scale were used for both horizontal and vertical measurements the line would appear more nearly straight. The figures at the left of the profile drawing show that the lowest point is about 627 feet above sea level, and the highest point is about 869 feet above sea level. Both drawings are necessary to give a complete picture of a proposed pipe line.

Questions to be answered about Sheet No. 255:

1. Where is the East end of the pipe line? ________________
2. What is the elevation of the East end? (Get this from the profile drawing.) ________________
3. What is total distance from Tulsa tank manifold to the Sand Springs, Oklahoma, manifold? ________________
4. What is the elevation of the top of the pump room floor at the Tulsa station? ________________
5. How are pipe line mile posts indicated? ________________
6. How are pipe line gate valves indicated? ________________
7. What is the elevation at the one-mile post? ________________
8. What is the elevation at the two-mile post? ________________
9. What is the elevation at the three-mile post? ________________
10. West Tulsa is in what Township North? ________________
11. West Tulsa is in what Range East? ________________
12. What are the civil engineers' station numbers on either side of Twister Creek? ________________
13. In what direction is the line running as it crosses the Arkansas River? ________________
14. In whose name is the property where the Box Canyon is located? ________________

Unit VI

GRAPHS, CHARTS, AND DIAGRAMS

There are several kinds of charts or diagrams with which the petroleum worker should be familiar. Charts, diagrams, etc., are drawn to no scale, their purpose being to give certain information. Many types of information can be charted or graphed and such a diagram reveals information at a glance which would be very difficult to show by using a long column of figures. Graphs and diagrams are, therefore, used to carry information and to show changes in conditions at the time these changes occur.

1. Process Flow Charts:

A very common type of chart in the petroleum industry is known as the "flow chart." This chart is intended to show the path of liquids or gases through a refining unit. Such a chart is shown in Fig. 14. Here the paths of liquids or gases may be traced from the fresh charge storage tank through the refining unit and to the storage tanks of the various products. A study of the figure will show that all of the crude product does not go through the same pipes.

Questions to be answered about Figure No. 14:

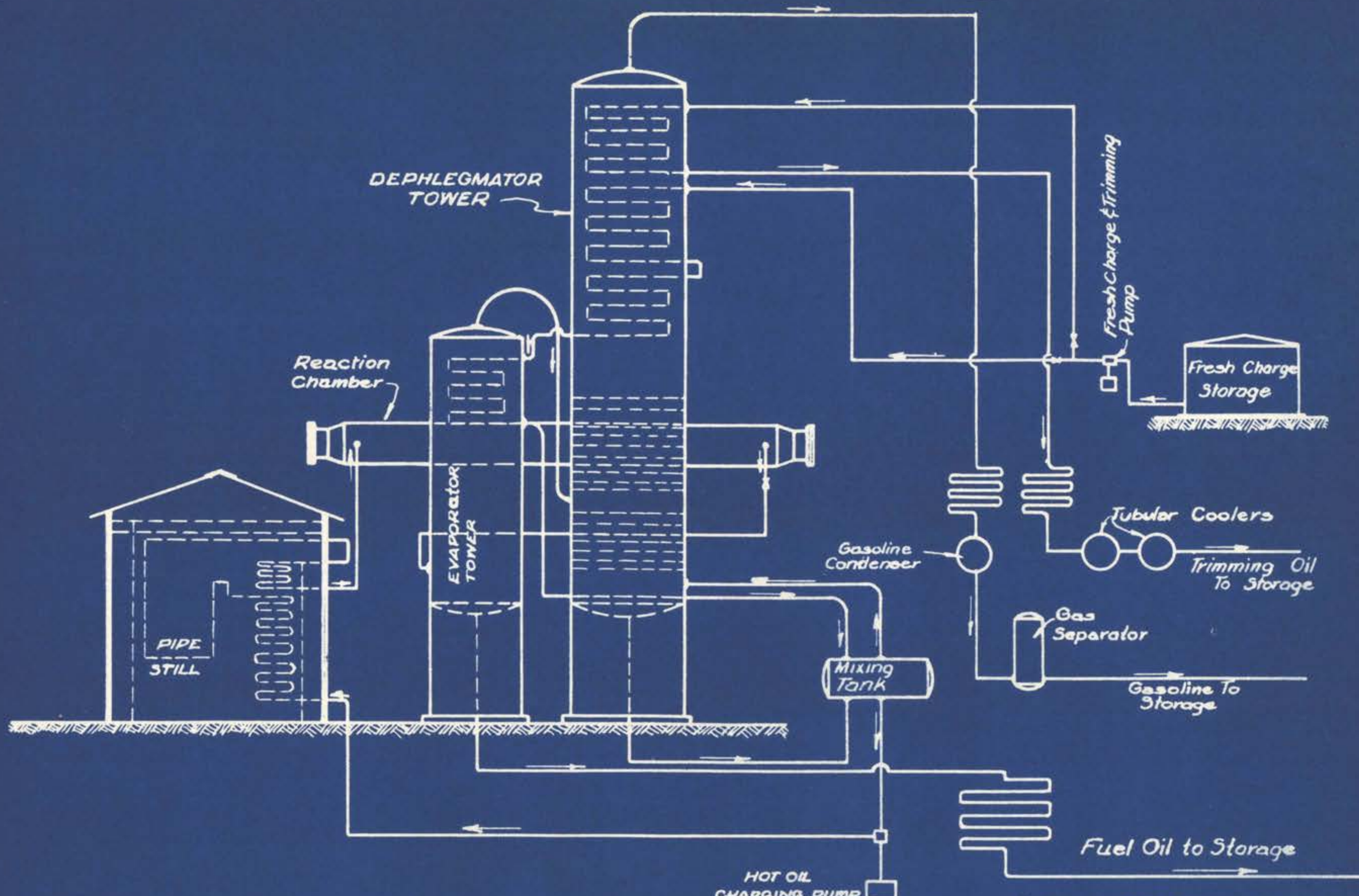
1. How many lines lead from the crude storage tank to the dephlegmator tower? ________________
2. Where does the oil entering the dephlegmator tower by the upper line from storage go to after it leaves the tower? ________________
3. Trace the path of the oil through the system that enters the dephlegmator tower by means of the lower line from fresh charge storage?______

There are many other flow charts used in the petroleum industry and the worker should become familiar with these as he has the opportunity.

2. Graphs:

Fig. 15 is a graph showing the daily average production of crude oil in the Mid-Continent field. Probably the average petroleum worker gives very little attention to such a sheet because it is really so many crooked lines and has very little meaning. This sheet really gives information very important to the petroleum worker. His job depends upon production of oil. If there is no oil produced then there is no oil to pump through the pipe line, and there is no oil to be refined. For this reason alone, graphs of this type should be of very great interest to the petroleum worker.

Fig. 16 shows the daily average production of crude oil in the Mid-Continent field over a two-year period, 1931 and 1932. The months of the year are listed along the upper side of the graph and each month is divided into weeks. The scales along the sides of the graph give the number of barrels produced on any day. The spaces between the horizontal lines represent 20,000 barrels of crude oil. The information which can be obtained at a glance from this chart is that there was more crude oil produced in 1931 than in 1932, thus indicated by the fact that the light line marked "1931" averages much higher than the dark line marked "1932." The spaces between the vertical lines represent a week, thus, the space between the first two vertical lines under the month of January is the week starting with the 2nd of January. The first space to the right is the 2nd week in January and starts with the 9th of January. The production of crude oil, therefore, on any day and especially the 1st day of any week can be very easily read from this graph.



CROSS CRACKING PROCESS FLOW CHART

(Courtesy M. W. Kellogg Co.)

FIGURE 14

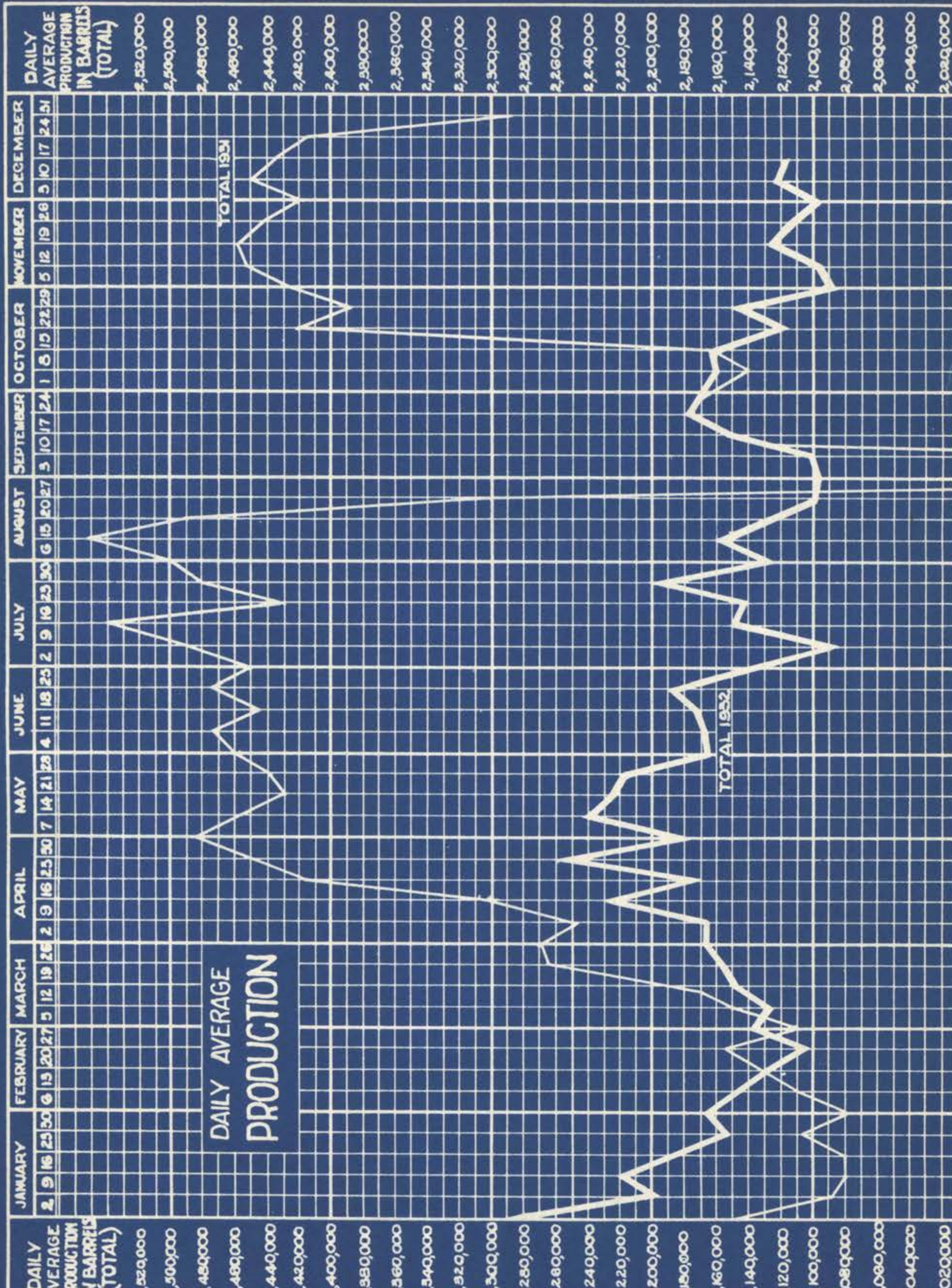
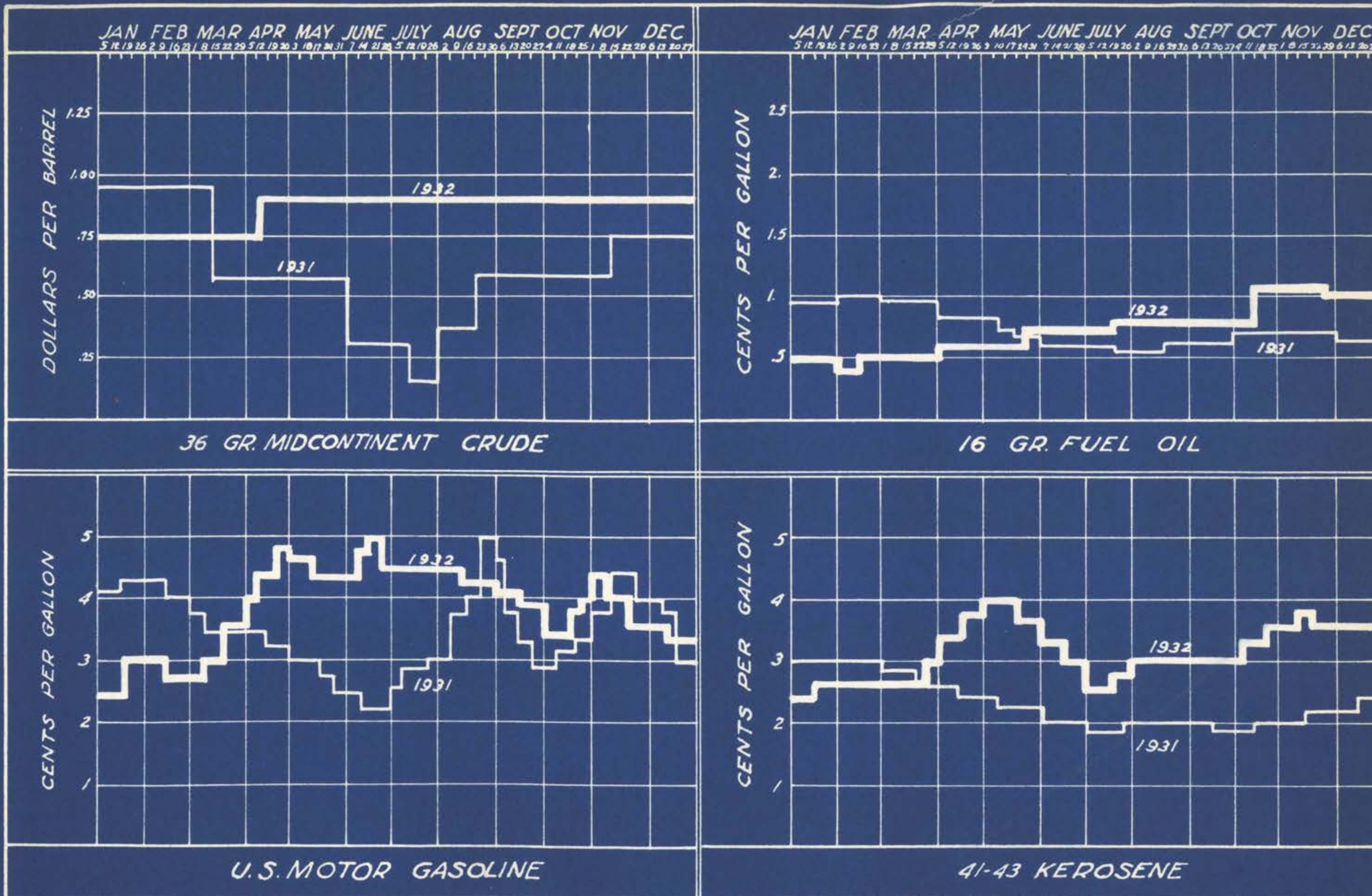
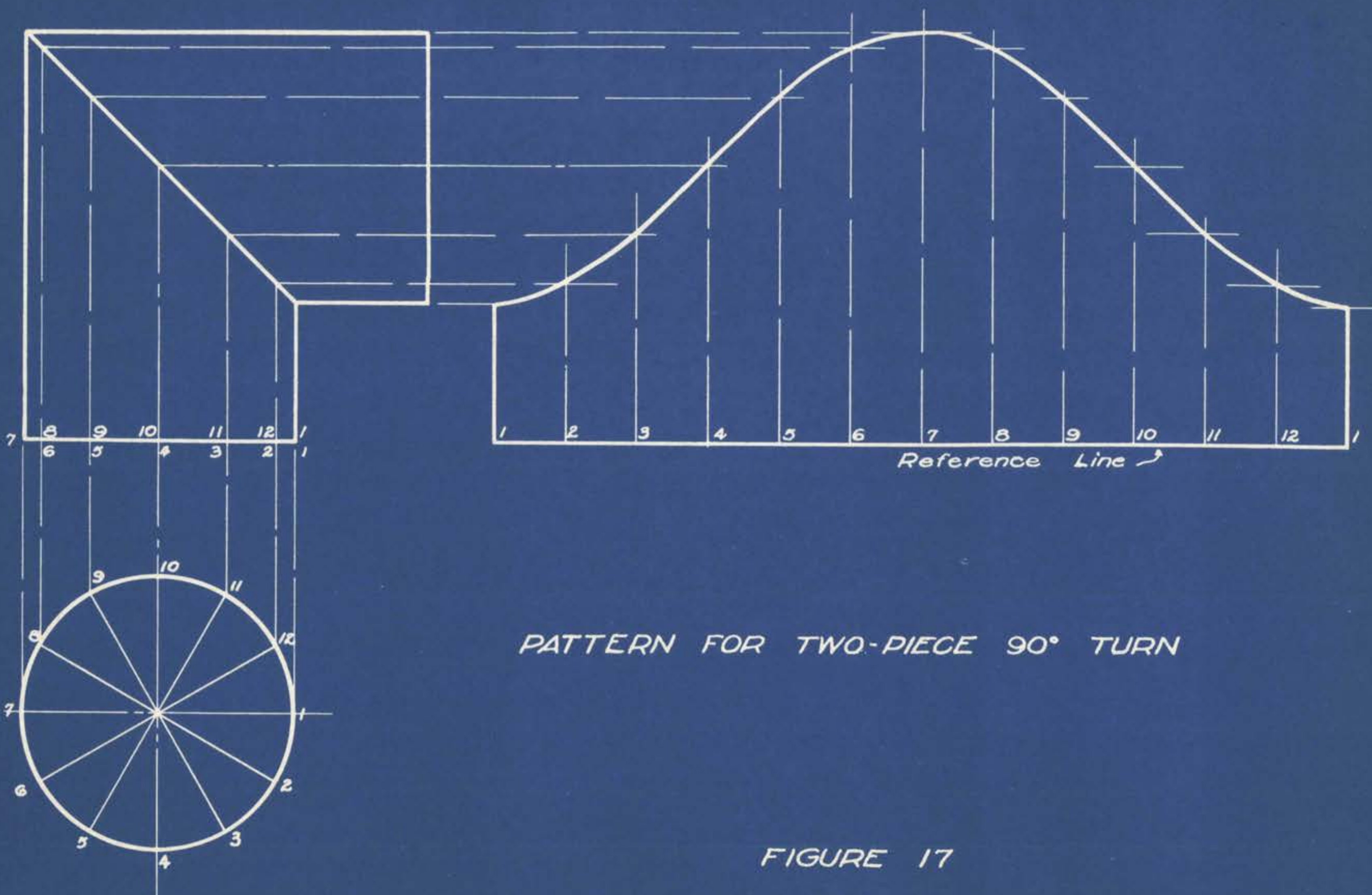

DAILY AVERAGE PRODUCTION
DAILY AVERAGE PRODUCTION IN BARRELS (TOTAL)
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
TOTAL 1951
TOTAL 1952
2,520,000
2,500,000
2,480,000
2,460,000
2,440,000
2,420,000
2,400,000
2,380,000
2,360,000
2,340,000
2,320,000
2,300,000
2,280,000
2,260,000
2,240,000
2,220,000
2,200,000
2,180,000
2,160,000
2,140,000
2,120,000
2,100,000
2,080,000
2,060,000
2,040,000
2,020,000

FIGURE 15



JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC
DOLLARS PER BARREL
1.25
1.00
.75
.50
.25
1932
1931
36 GR. MIDCONTINENT CRUDE
CENTS PER GALLON
2.5
2.
1.5
1.
.5
16 GR. FUEL OIL
5
4
3
2
1
U.S. MOTOR GASOLINE
41-43 KEROSENE

FIGURE 16



PATTERN FOR TWO-PIECE 90° TURN

FIGURE 17

Questions to be answered about Figure No. 15:

1. How much crude oil was produced on May 7, 1931? ________________
2. How much more crude oil was produced on November 19, 1931, than on November 19, 1932? ________________
3. On which day was the most crude oil produced over the two-year period? ________________
4. On which day was the most crude oil produced in 1932? ________________
5. Which three months of 1931 produced the most crude oil? ________________
6. Which month of 1931 produced the least amount of crude oil? ________________
7. Which month of 1932 produced the least amount of crude oil? ________________

Fig. 16 is four graphs, comparing the prices of crude oil, gasoline, fuel oil and kerosene for the years 1931 and 1932. These graphs again should be of vital importance to the petroleum worker as his wages depend on the volume of production and the market price of his product. These graphs are very similar to Fig. 15. The weeks and months are shown at the top of the sheet and these apply also to the graphs at the bottom of the sheet. The price per unit is shown at the left side of each graph. For example: the price of crude oil is shown in dollars per barrel and the price of fuel oil is shown in cents per gallon. These graphs show at a glance the price of a product at any specified date, and, also compares this price with the year previous.

Questions to be answered about Figure No. 16:

1. Was the price of crude oil more uniform in 1931 or 1932? ________________
2. What was the price of crude oil during the month of February 1932? ________________
3. What was the price of fuel oil during the month of January 1932? ________________
4. In which year did fuel oil reach the higher price in 1931 or 1932? ________________
5. How do the prices of fuel oil during the two years 1931 and 1932 compare? ________________
6. How do the prices of kerosene for the two-year period compare? ________________
7. What was the highest price for which kerosene sold in 1932? ________________
8. In which year did U. S. Motor Gasoline hit the lowest price? ________________
9. What was the price of U. S. Motor Gasoline during the first two weeks of February 1932? ________________
10. What was the price of U. S. Motor Gasoline during the same period of 1931? ________________
11. How do the prices of U. S. Motor Gasoline in 1932 compare with those in 1931? ________________

Unit VII

LAYOUT WORK FOR WELDERS—SHEET METAL WORKERS—AND LEAD BURNERS

This unit will be of interest only to welders and those planning to take up welding as a trade. Many young welders think that the important thing is to learn how to hold a torch or make an arc, but they soon learn that they must be able to lay out patterns. The patterns for most common joints and fittings are available in welding shops as these are laid out by one method or another and transferred to gasket material.

There are several methods of laying out patterns. Some methods require the use of tables and others do not. The following patterns can be laid out by the use of the steel square with sufficient accuracy for the average job. The method used is rather simple after the workman gets the idea, and the principle may be applied to most any welding layout problem.

1. Pattern For a Two-Piece 90° Turn:

The first thing in working with round pipe is to forget that the pipe is round and to think of it as having some number of sides. This number is usually taken as twelve and in laying out the pattern there will always be twelve spaces or thirteen points. Fig. 17 shows a pattern for a two-piece 90° turn. The drawing on the left-hand side of the sheet shows the front view of the turn, and the circle below shows how the round pipe is divided into twelve equal parts. The distance between the reference line and the intersection of the two pipes makes no difference, this difference being sufficient to give a substantial pattern when laid out on gasket material.

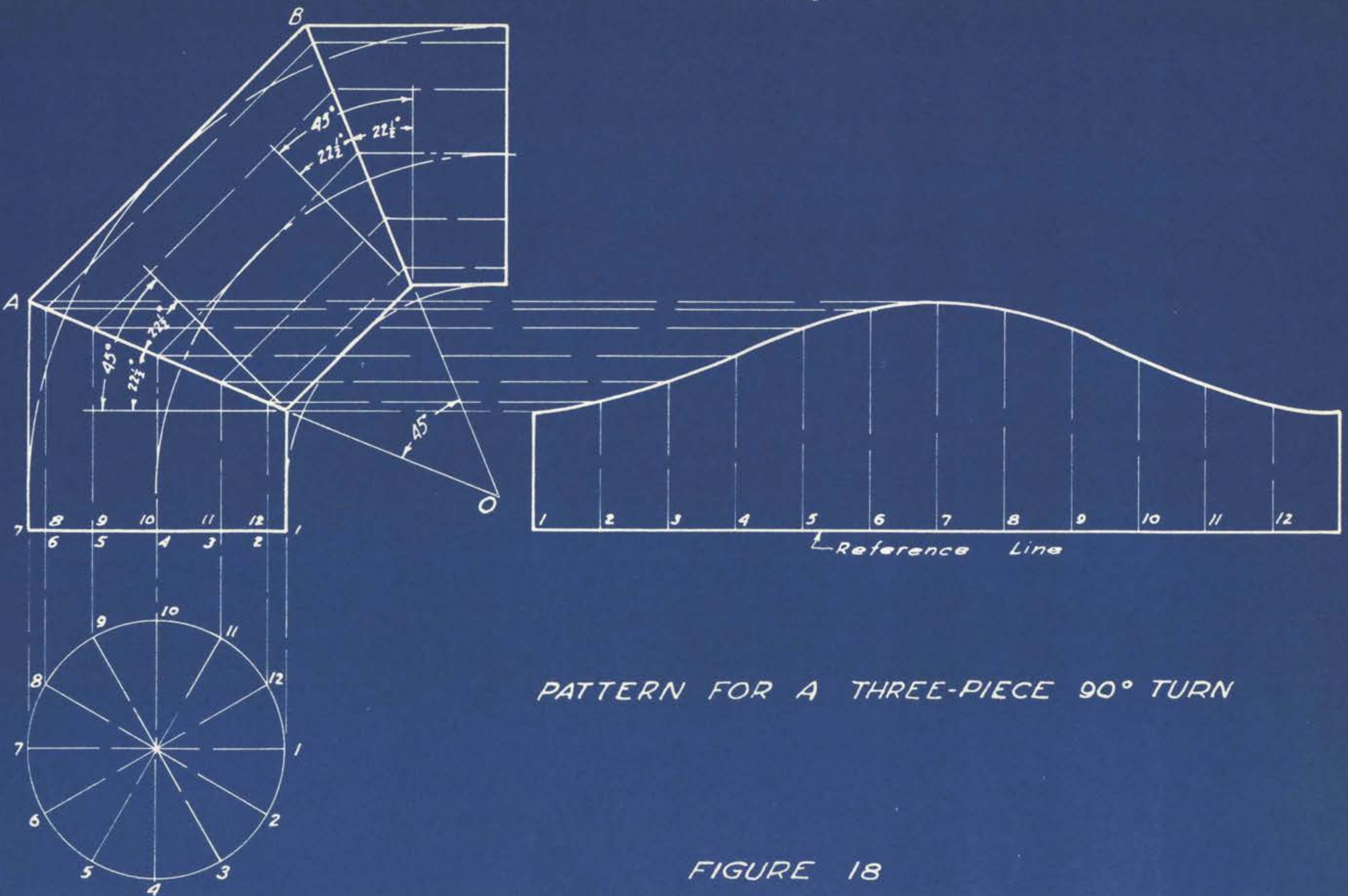
The length of the reference line may be laid out by setting off twelve spaces with dividers or compass equal to the twelve spaces on the circle. The diameter of the circle is equal to the outside diameter of the pipe to be used. The length of the vertical lines are laid off equal to the length of the corresponding vertical line in the front view of the 90° turn. The student should draw patterns using this method for several sizes of pipe, which he may have opportunity to use. The curve may be drawn by connecting the points freehand.

2. Pattern for a Three-Piece 90° Turn:

The procedure in this problem, Fig. 18, is very much the same as in drawing the pattern for the two-piece 90° turn. The distance from the reference line to the first intersection is taken as any convenient length so as to make a substantial pattern. The circle is divided into twelve equal parts and these spaces are set off on the reference line using the dividers or compass. The lengths of the vertical lines in the pattern are obtained by projecting over from their corresponding lines in the front view. The radius of the sweep is shown by using "O" as the center and the distance to the center line as the radius. In drawing the front view for the three-piece turn the line "OA" should be drawn and extended as far as desired, thus making a long radius or short radius sweep. It should be noticed that the angle between "AO" and "BO" is 45°. The same pattern can be used no matter what radius sweep is desired, the difference being only in the length of the center piece of the elbow.

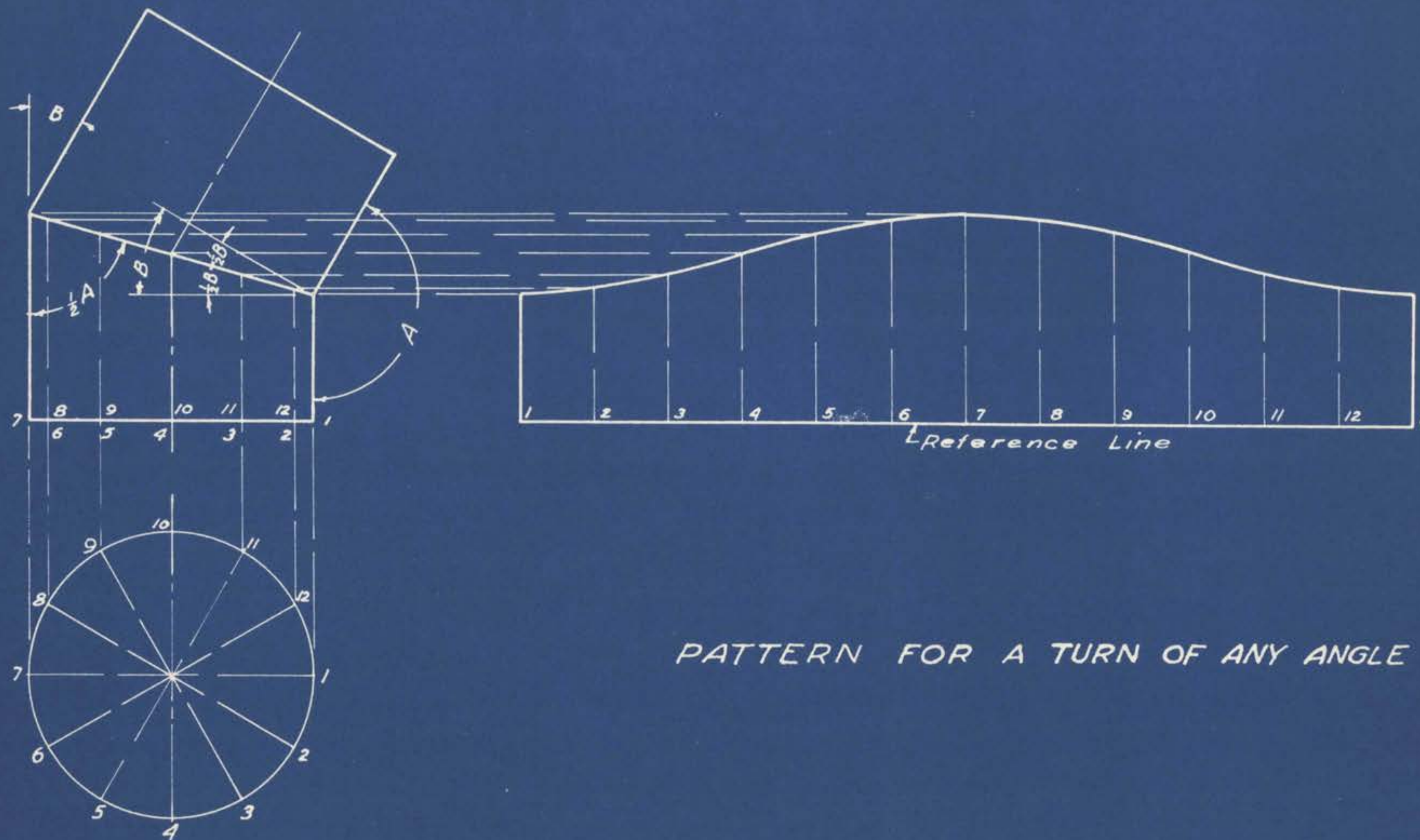
3. Pattern For a Turn of Any Angle:

The procedure for drawing a turn of any angle, Fig. 19, is practically the same as in the two preceding problems. It is first necessary to draw a front view of the turn and to proceed in laying out the development in the usual manner. This method



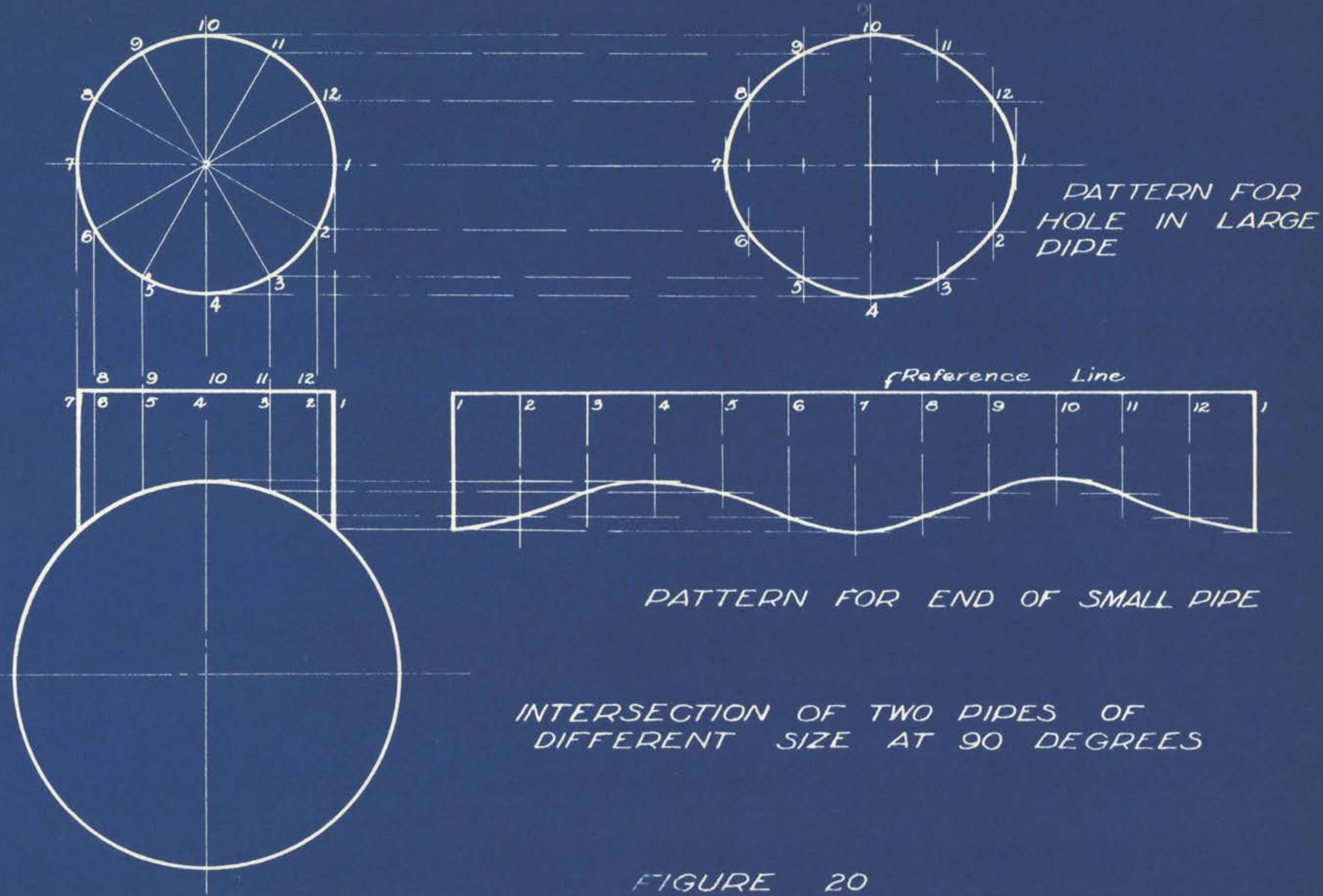
PATTERN FOR A THREE-PIECE 90° TURN

FIGURE 18



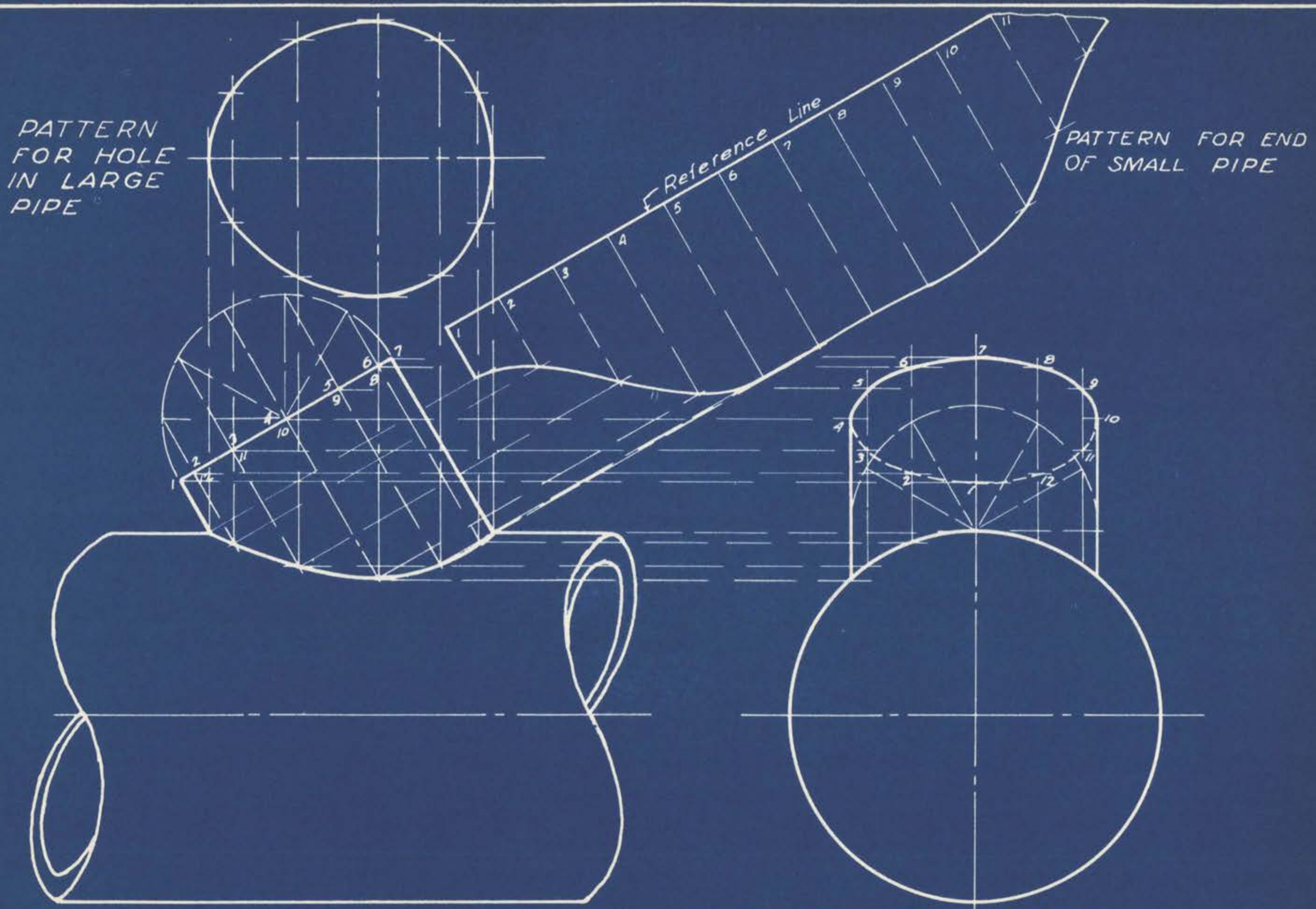
PATTERN FOR A TURN OF ANY ANGLE

FIGURE 19



INTERSECTION OF TWO PIPES OF DIFFERENT SIZE AT 90 DEGREES

FIGURE 20



INTERSECTION OF TWO PIPES AT ANY ANGLE

will apply to any turn and any size pipe after the front view is drawn. The drawing should be as accurate as possible so that the joint will fit closely.

4. Intersection of Two Pipes of Different Size at 90°:

The procedure in this case, Fig. 20, is to draw an end view of the connection looking into the larger pipe and the smaller pipe pointing up. A circle is drawn directly above the smaller pipe and divided into the usual twelve parts. The points on the circle are projected down across the small pipe until they touch the large pipe. These lines running along the small pipe are called elements, and the elements show in their true length. The reference line is drawn and twelve spaces are set off and the length of each element is projected over to the corresponding element or vertical line in the pattern. A smooth curve drawn through the resulting points gives a pattern for the end of the small pipe. The hole to be cut in the large pipe may be laid out by placing the end of the small pipe against the large pipe and marking around it. This is the usual procedure. If the welder should need a pattern for the hole, the method for drawing the pattern also is shown. The width of the pattern is the same as the diameter of the small pipe and is found by projecting over from the circle. The length of the pattern is the length of the curved part of the large pipe under the small pipe. The center line should be drawn first and the spaces on either side of the center line set off with the dividers, taking the measurements along the curved surface of the large pipe. The resulting points may be connected with a smooth curve drawn freehand.

5. Intersection of Two Different Sized Pipes at Any Angle:

Two views are needed in order to lay out this pattern as is shown in Fig. 21. The front view is drawn showing the angle with which the small pipe intersects the large pipe. A half-circle is drawn at the end of the small pipe in order to obtain the usual spaces. The half-circle is sufficient to draw the elements but the complete circle has been used in the preceding problems in order that the student may better understand the procedure. The elements are drawn along the small pipe but the point where the elements intersect the large pipe can not be determined at this time. The end view must next be drawn looking directly into the large pipe. The half-circle is again drawn and the elements are drawn along the small pipe and in this view the intersection of the elements of the small pipe with the large pipe can be seen. The point of intersection of each element is projected horizontally across to the corresponding element in the front view. The resulting points may be connected with a freehand curve and thus we have the line which is the intersection of the two pipes. The reference line for the pattern is drawn at a 90° angle with the small pipe and laid off into the usual twelve spaces. The length of each element of the pattern may be projected from its corresponding element in the front view and by connecting the resulting points we have a pattern for the end of the small pipe.

The pattern for the hole in the large pipe is drawn easily at this time. The length of the pattern may be projected up from the front view as shown. The width of the pattern is equal to the diameter of the small pipe. By projection up the points of intersection of the elements of the small pipe and the large pipe from the front view and drawing a horizontal center line and laying off the distance of each element from the center line, points are obtained through which a smooth curve may be drawn, and we have a pattern for the hole in the large pipe.

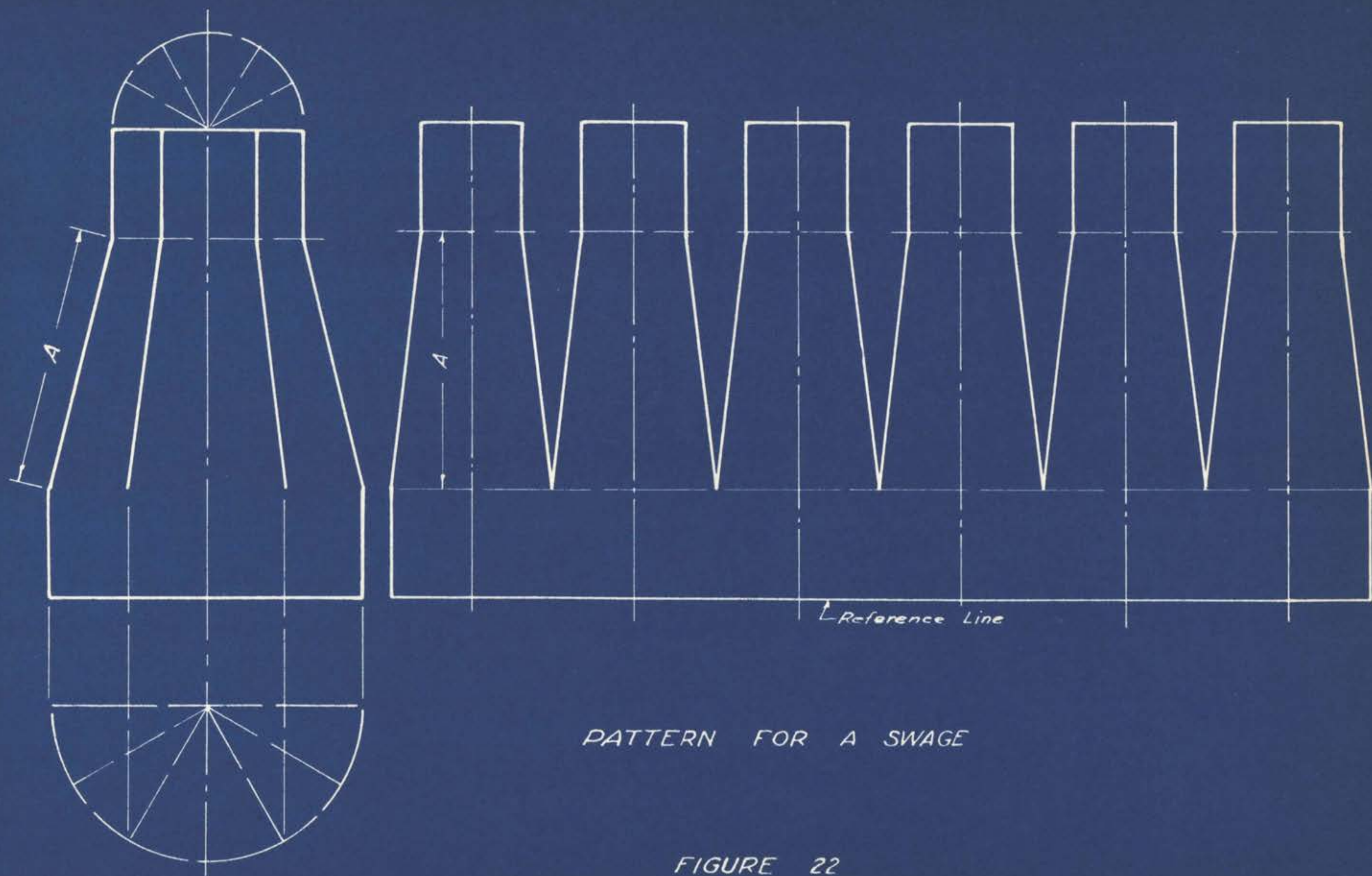
6. Pattern for a Swage:

The front view is drawn for a swage as shown in Fig. 22. The half-circles are drawn so as to give the elements required. The number of sections required for a swage depends upon the size of both pipes. The dimension "A" also will depend upon the size of the two pipes. The reference line is drawn in the usual manner and the twelve parts laid off if a swage of six sections is desired. Every other point on the reference line will in this case be a center line and every other point will be an outline of the pattern. The distance "A", as shown in the front view, is measured off vertically on the pattern and the dividers or compass is set equal to the spaces on the small circle and this is laid off on each side of each center line. The points are then connected, and we have a pattern for a swage.

7. Pattern for an Orange Peel Bull Plug:

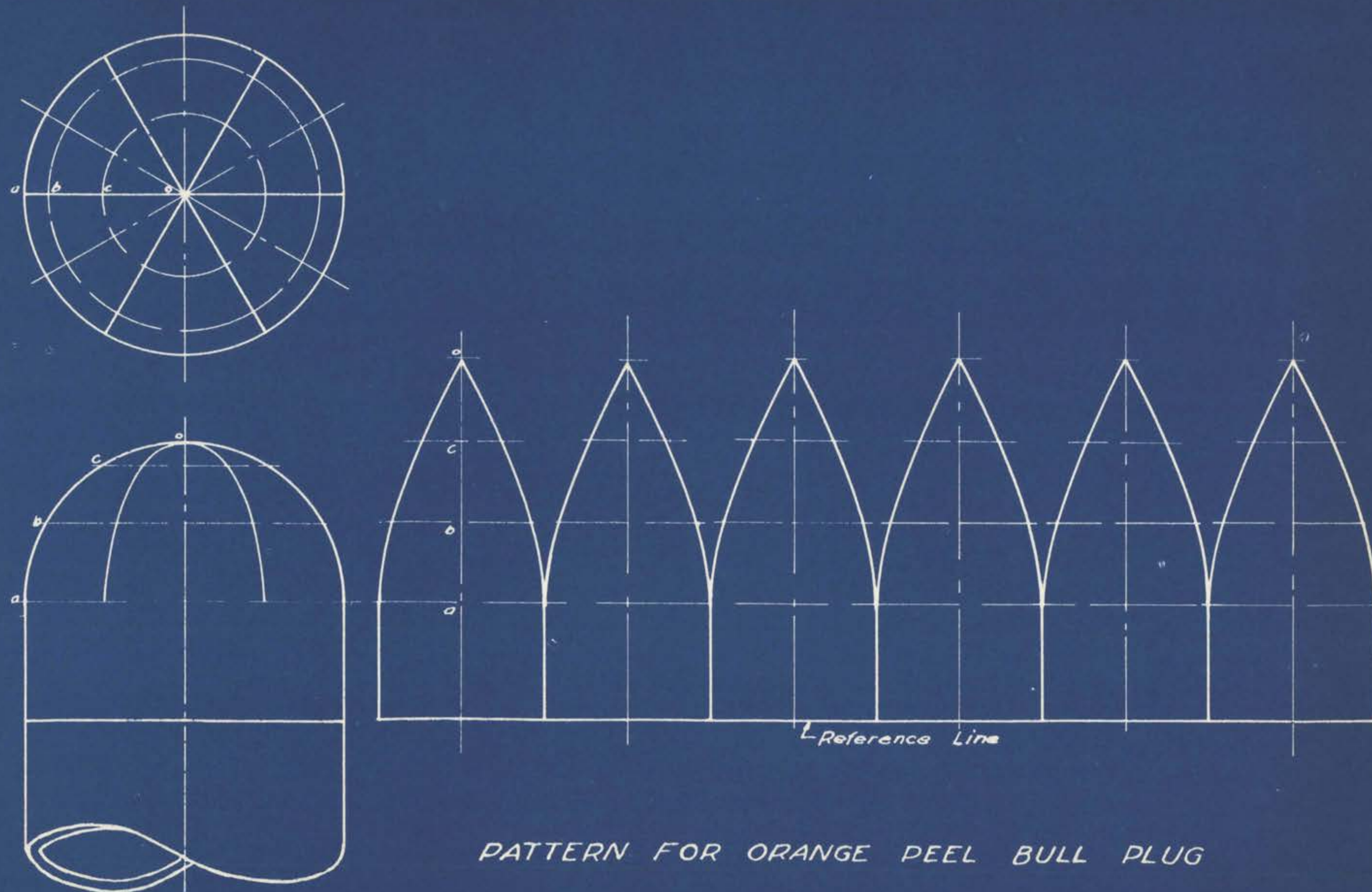
Fig. 23 shows a pattern for an orange peel bull plug. The front view of the bull plug is drawn first. The top view is drawn next and divided into the usual twelve spaces. As the bull plug is a half-circle, the distances "AB", "BC", and "CO" on the front view may be laid out equal to the space used for laying out the reference line as obtained from the twelve spaces in the top view. The points "B" and "C" may be projected to the top view and circles may be drawn using "O" as a center, which shows the smaller circles as they would appear in the top view. In the pattern, spaces "AB", "BC", and "CO" are laid out equal to the corresponding spaces in the front view. The measurements on either side of the center line are obtained from the measurements on either side of the center line on the corresponding circle in the top view. The points thus obtained may be connected by a smooth freehand curve, and we have a pattern for a bull plug.

If these problems are worked out in class the student should make it a point to work out patterns for many different sized connections and pipes in order that he may fix firmly in his mind the method of drawing patterns and at the same time obtain patterns which he may be able to use in the field. These patterns should all be drawn on good paper so that they may be transferred to gasket material for actual use in the field.



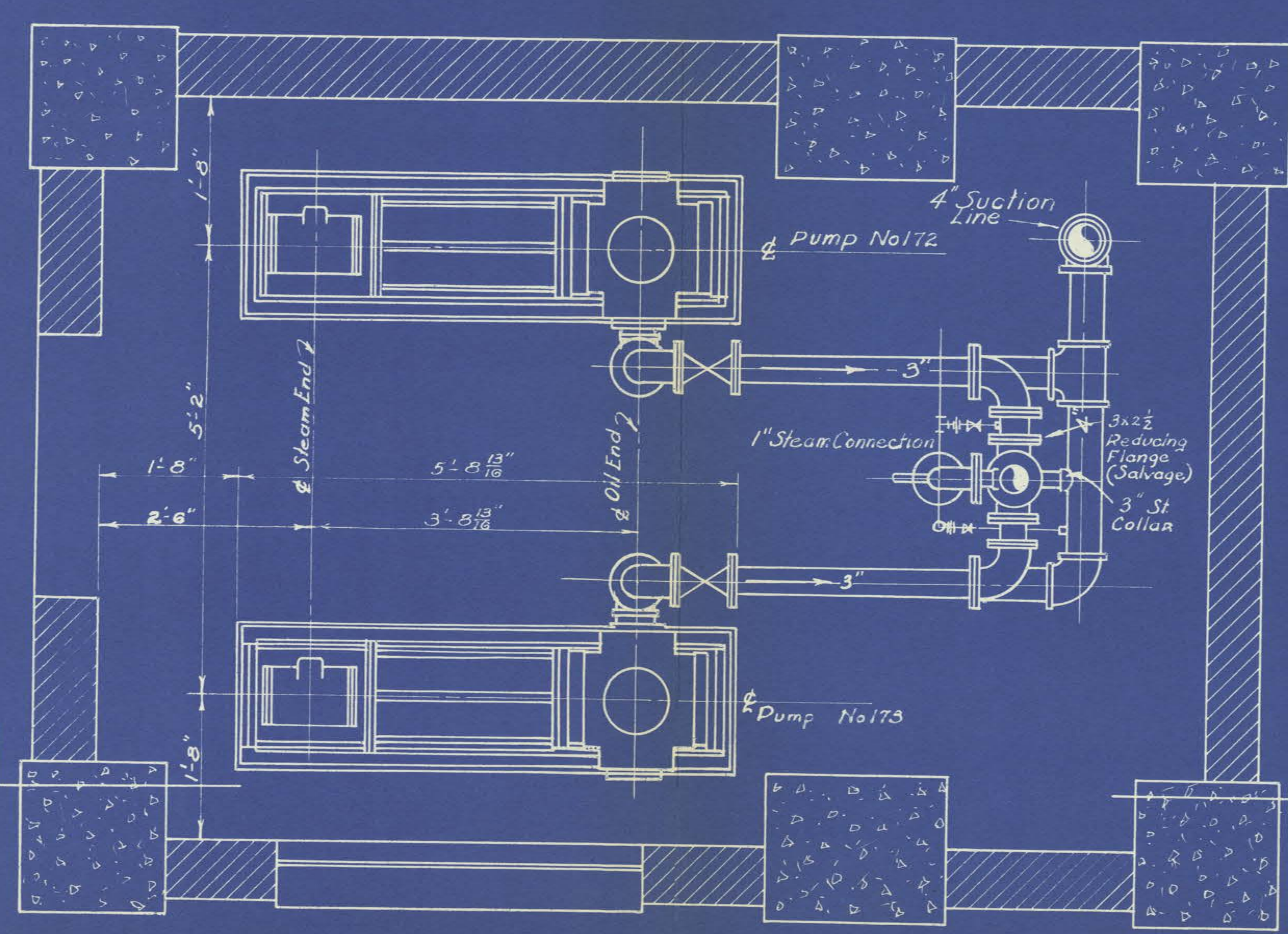
PATTERN FOR A SWAGE

FIGURE 22



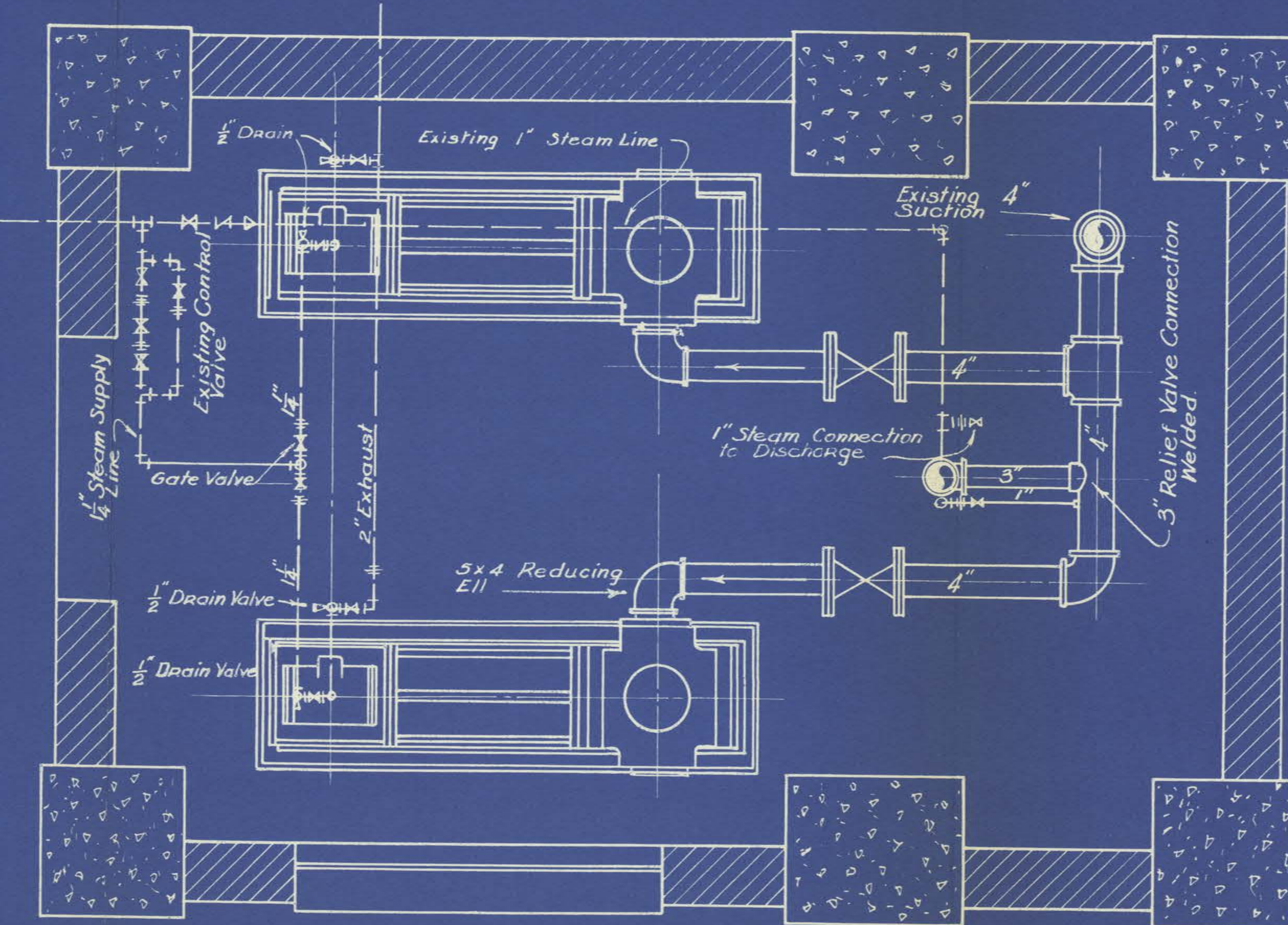
PATTERN FOR ORANGE PEEL BULL PLUG

FIGURE 23



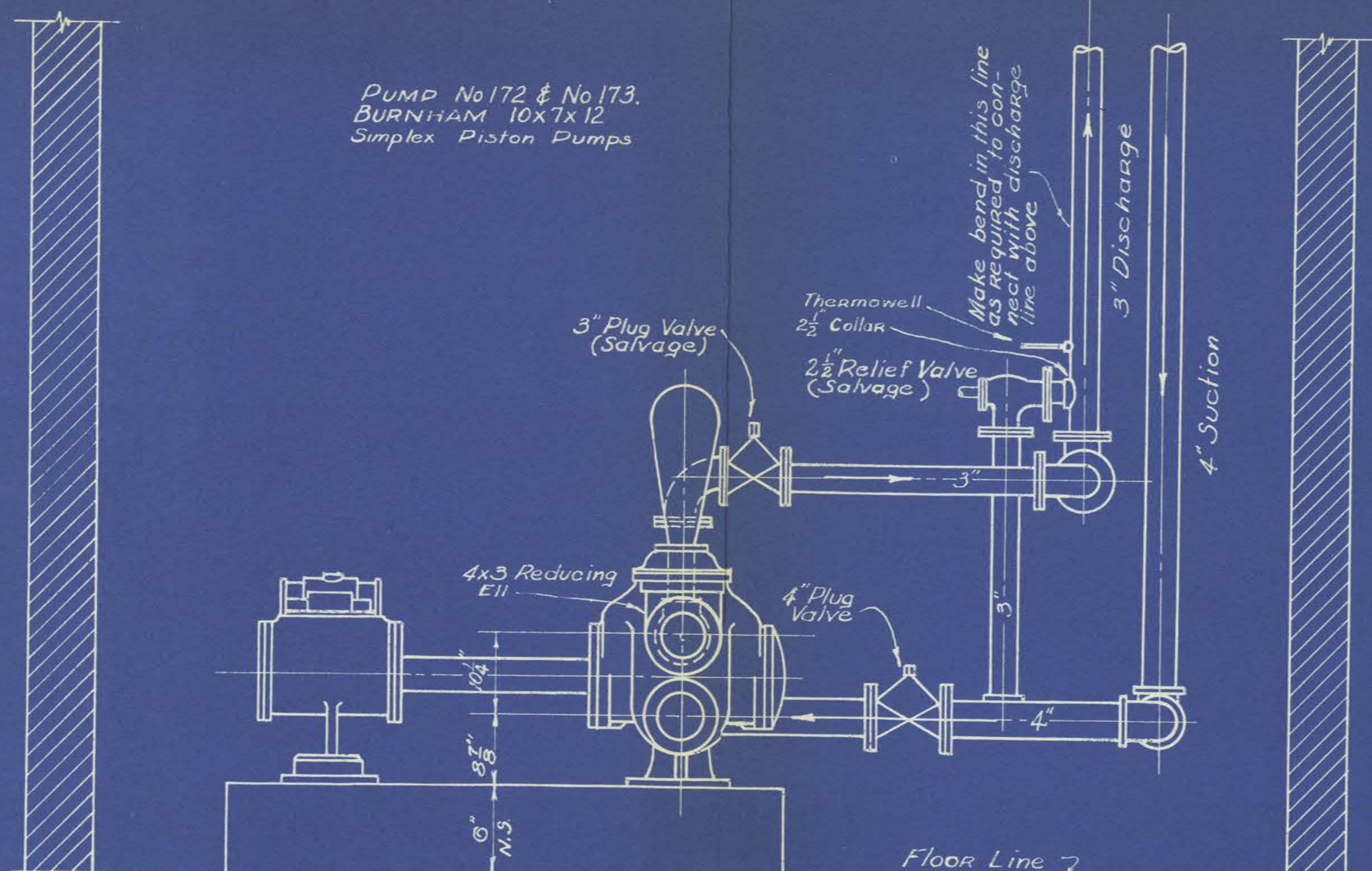
PLAN OF DISCHARGE LINES

Scale - 3/4" = 1'-0"



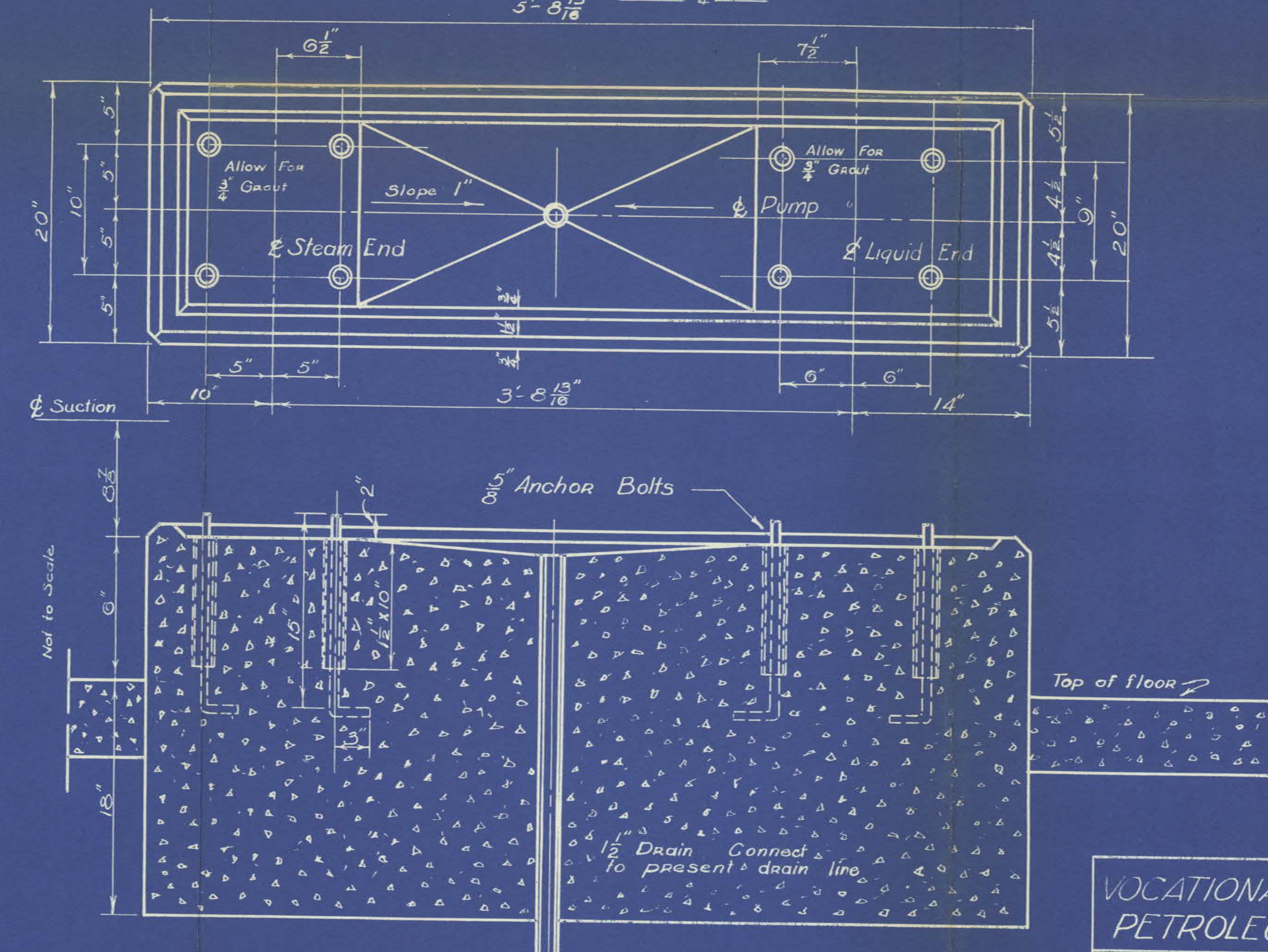
PLAN OF SUCTION LINES

Scale 3/4" = 1'-0"



SECTION A-A

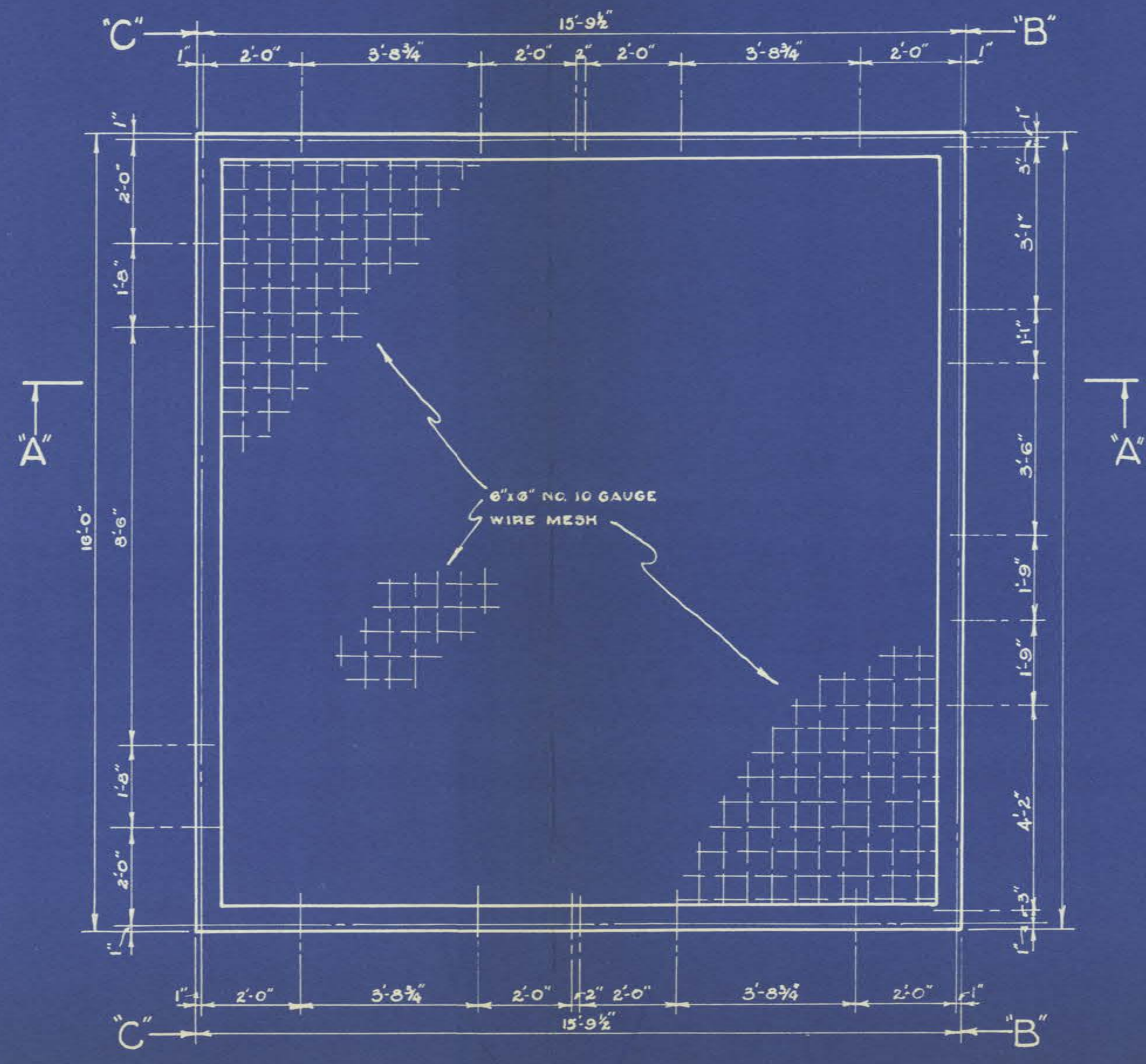
Scale 3/4" = 1'-0"



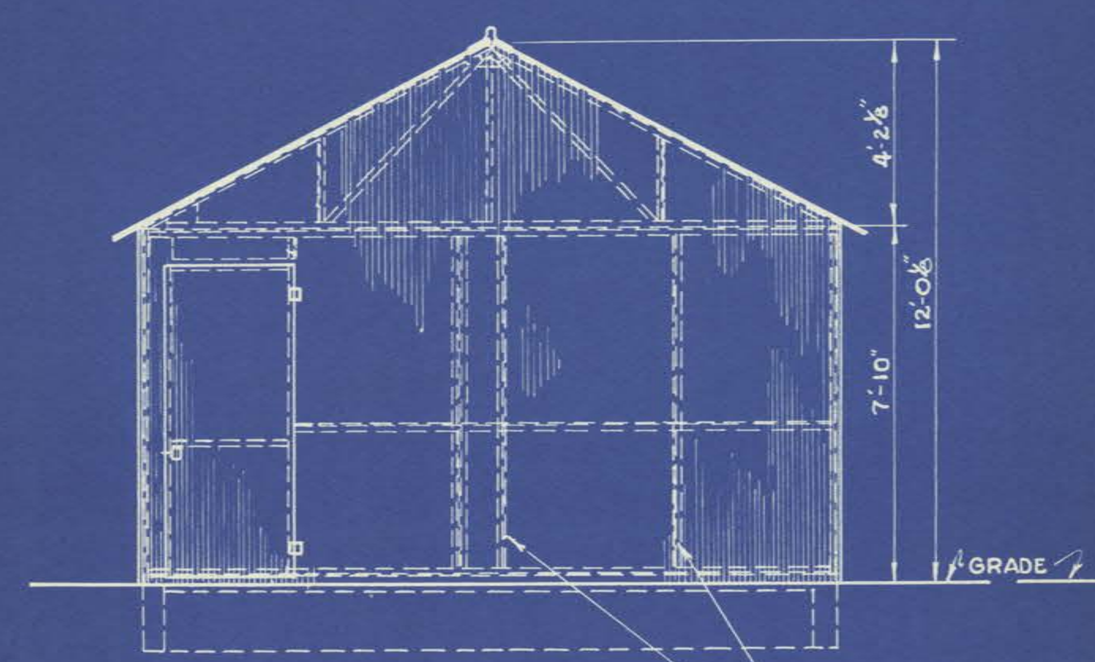
FOUNDATION DETAIL

Scale 1/2" = 1'-0"

VOCATIONAL TRAINING COURSES PETROLEUM INDUSTRY SERIES		
REPLACE PUMP No173 CHARGING CYLINDER STOCK		
Date 7-29-37 Scale As Shown	BY M.L. POWERS	SHEET 101

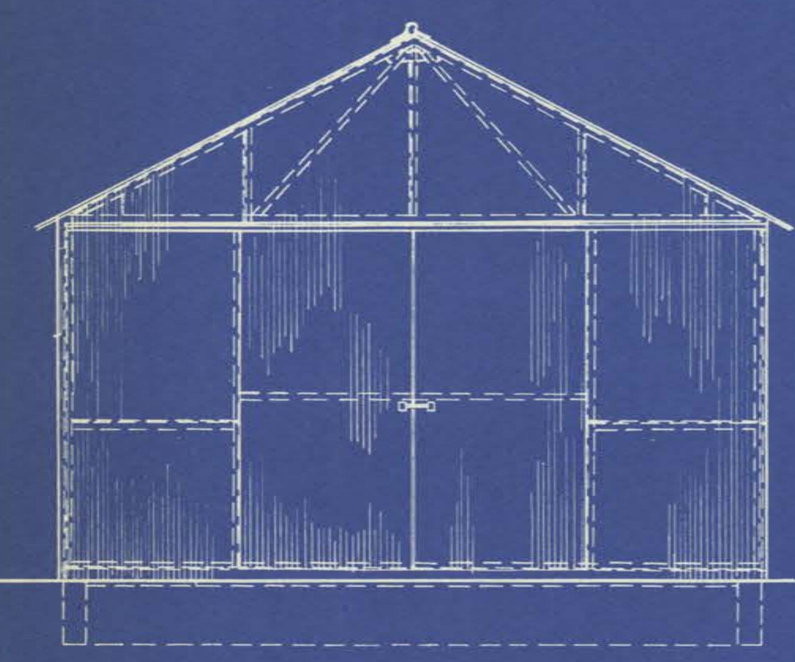


PLAN
SCALE: ⅜"=1'-0"

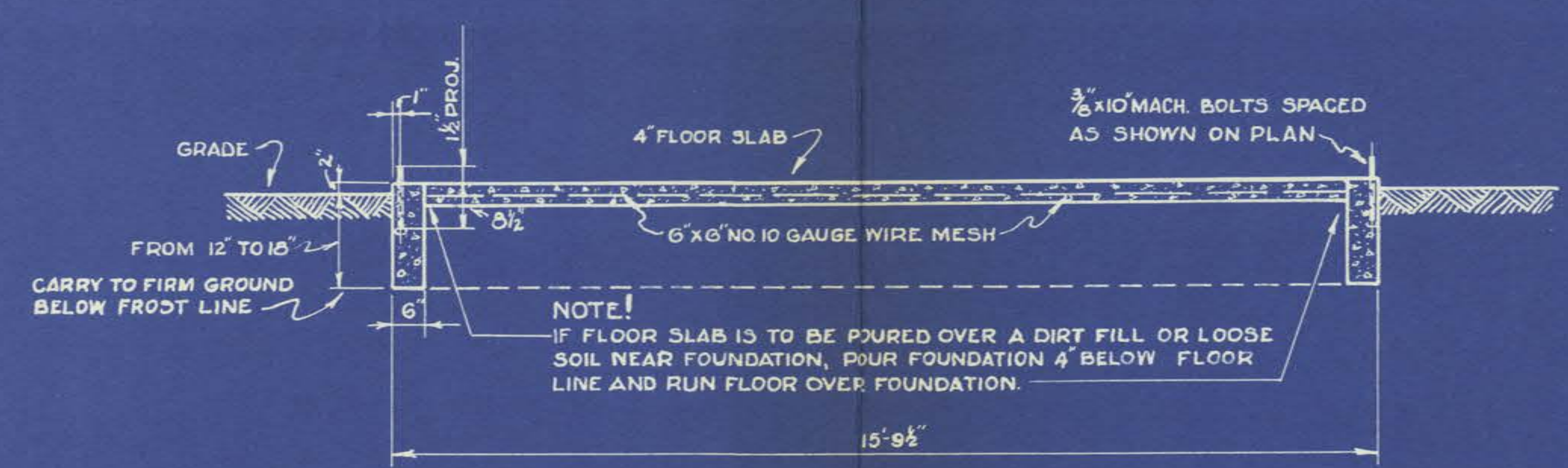


REAR ELEVATION
AT "B-B"
SCALE: ¼"=1'-0"

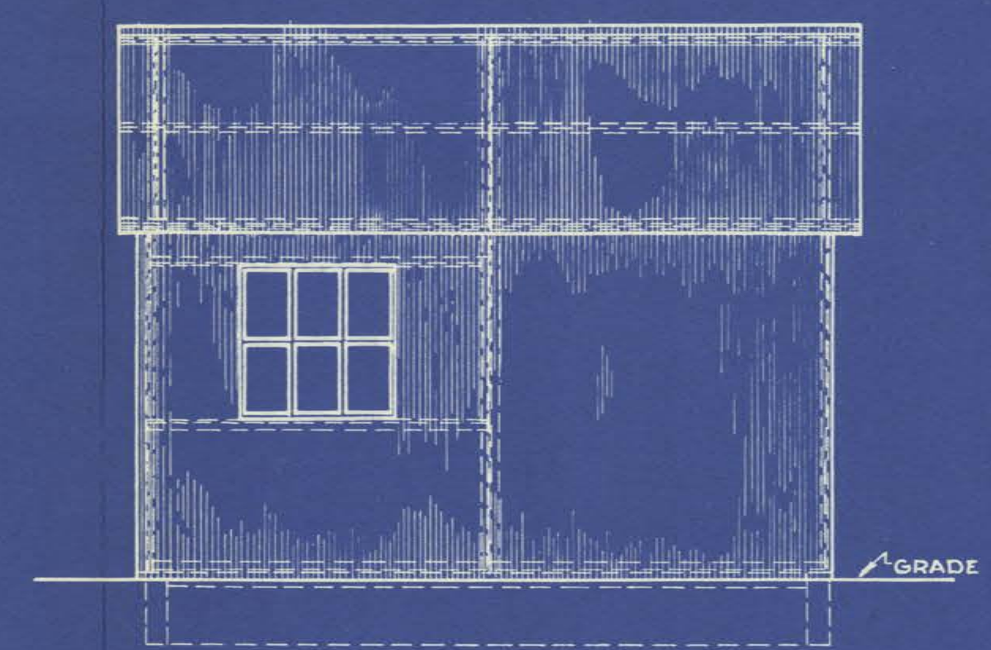
NOTE!
COVER PRESENT BELT OPENING WITH NECESSARY #28 GA. GALV. CORR. IRON & ANGLE GIRTS.



FRONT ELEVATION
AT "C-C"
SCALE: ¼"=1'-0"



SECTION "A-A"
SCALE: ⅜"=1'-0"



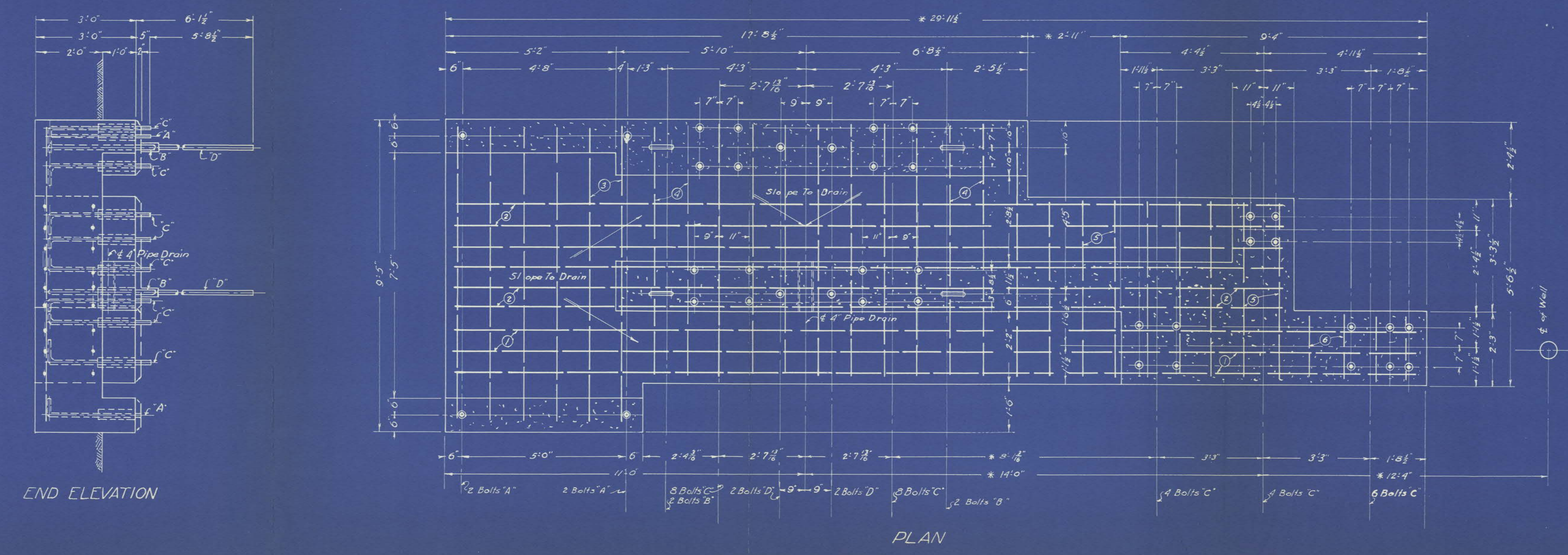
SIDE ELEVATION
OPPOSITE SIDE REVERSE
SCALE: ¼"=1'-0"

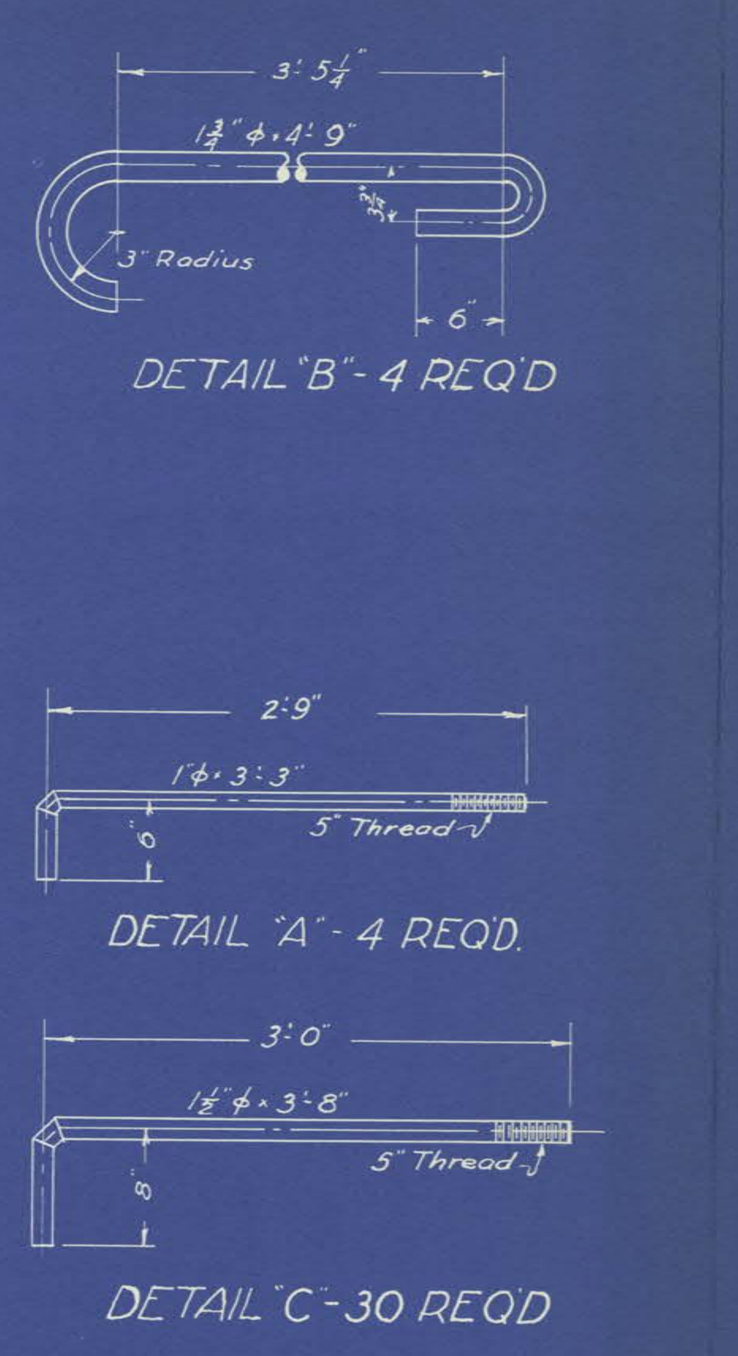
MATERIAL REQ'D.	
6 CU. YDS.	38 SACKS PORTLAND CEMENT
1:2:4	2.7 YDS. CLEAN RIVER SAND
CONCRETE	5.4 YDS. CRUSHED ROCK
27	⅝" x 10" MACH. BOLTS THREADED 2"

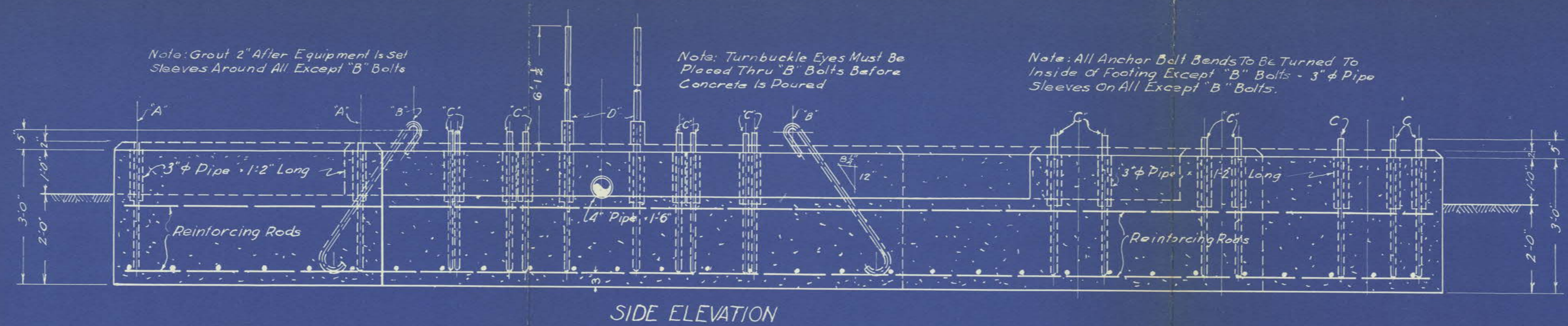
VOCATIONAL TRAINING COURSES
PETROLEUM INDUSTRY SERIES

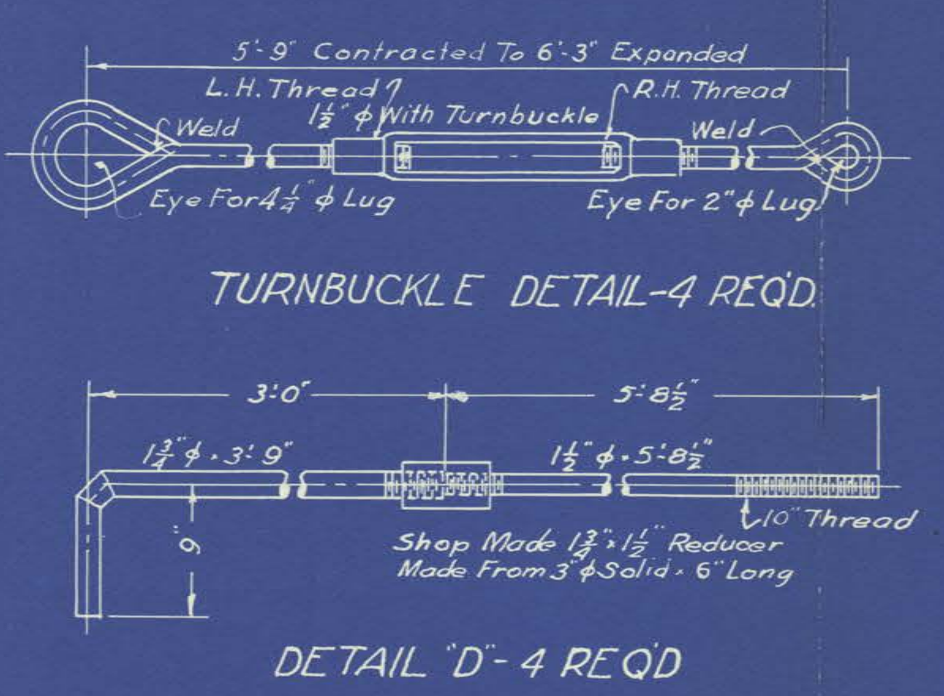
FOUNDATION PLAN FOR
LEASE TOOL HOUSE

Date 8-29-37 Scale As Shown	BY M.L. POWERS	SHEET 102









Note: These Dimensions Are For A 25'-0" ℄ To ℄ Beam And Dimensions Marked Thus * Are To Be Adjusted As Required For Any Other Length Beam. Add or Subtract 1.2 Cu. Yards Of Concrete And .026 Cu. Yards Of Grout Per Foot Change in Footing Length. Bolts "A", "C", "D" To Be Furnished With 1 Hex Nut Each.

MATERIAL SCHEDULE

Item	No.	Size	Location	Length	Description
1	6	¾" ϕ	Longitudinal	* 29'-4½"	Reinforcing
2	12	"	"	* 25'-4"	"
3	6	⅝"·¾", or ⅞" ϕ	Cross	8'-11"	"
4	12	"	"	7'-5"	"
5	8	"	"	5'-0"	"
6	4	"	"	1'-9"	"
"A"	4	1" ϕ	Sand Reel	3'-3"	Anchor Bolts
"B"	4	1¾" ϕ	Jack Post	4'-9"	" "
"C"	30	1½" ϕ	J.P. & S.P.	3'-8"	" "
"D"	4	1½" & 1¾" ϕ	Jack Post	9'-5½"	" "
T.B	4	1½" ϕ	" "	5'-9" To 6'-3"	" "
7	1	4" ϕ Pipe	" "	1'-6"	Drain
8	38	3" ϕ "	"A" "D" "C"	1'-2"	Sleeves
9	.534	Cu. Yds	Grout	*	Grout
10	18.3	" "	Concrete	*	Class "B"

VOCATIONAL TRAINING COURSES
PETROLEUM INDUSTRY SERIES

FOUNDATION DETAILS
SAMPSON POST AND JACK POST

Date 7-15-37
Scale As Shown

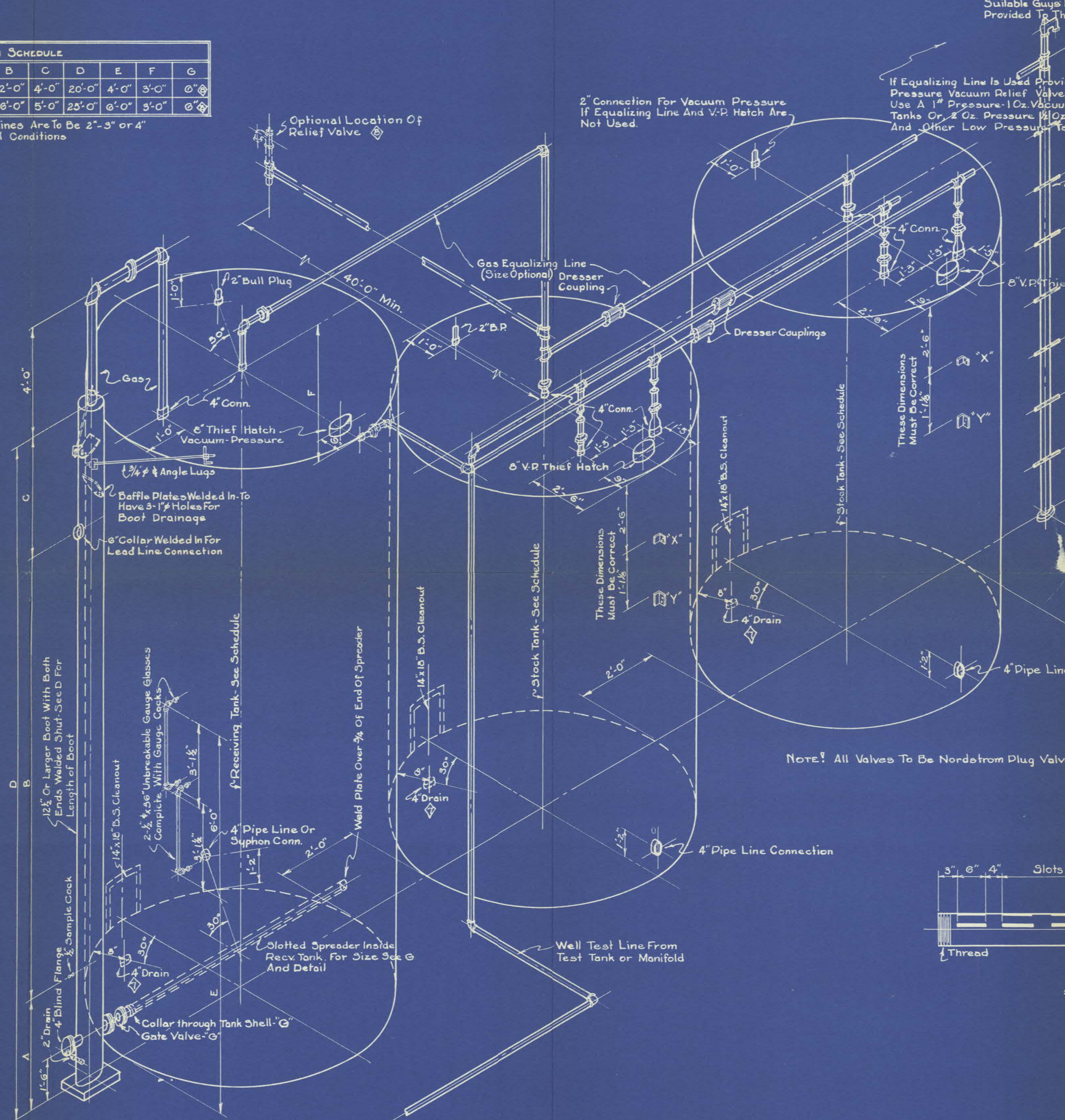
BY M.L. POWERS

SHEET 103

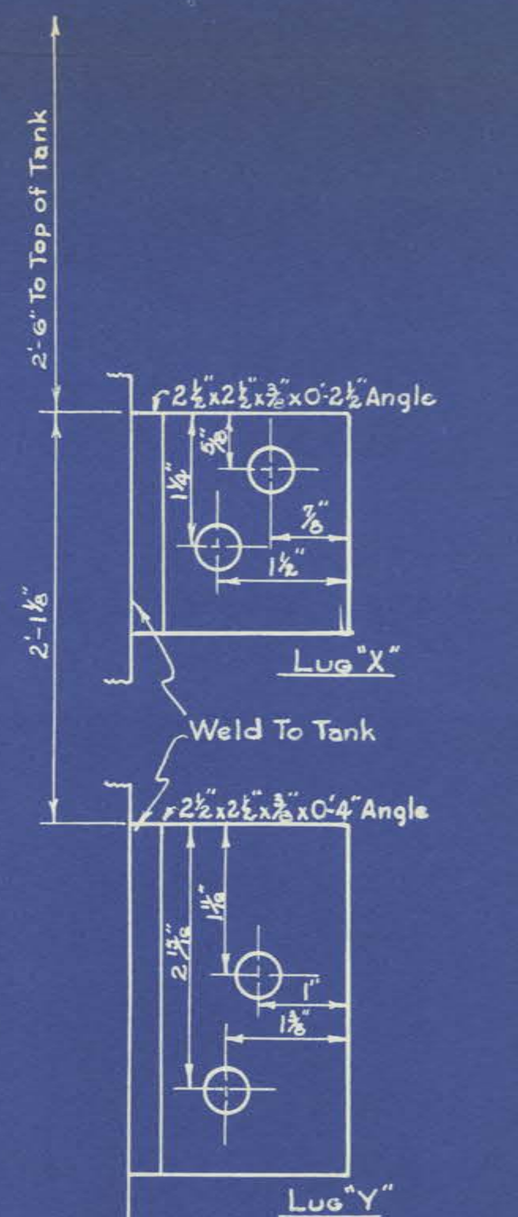
Dimension Schedule

Stock Tanks	Recv. Tank	A	B	C	D	E	F	G
8'-0" x 12'-0"	8'-0" x 17'-9"	4'-0"	12'-0"	4'-0"	20'-0"	4'-0"	3'-0"	6"
10'-0" x 15'-0"	10'-0" x 22'-6"	4'-0"	16'-0"	5'-0"	25'-0"	6'-0"	3'-0"	6"

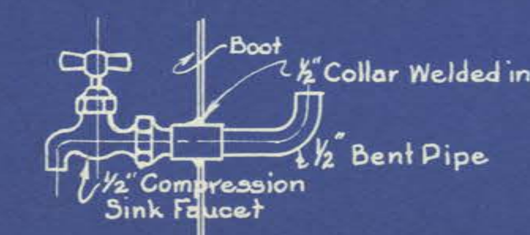
Note! Unless Otherwise Noted All Lines Are To Be 2"-3" or 4" Depending On Lease and Well Conditions



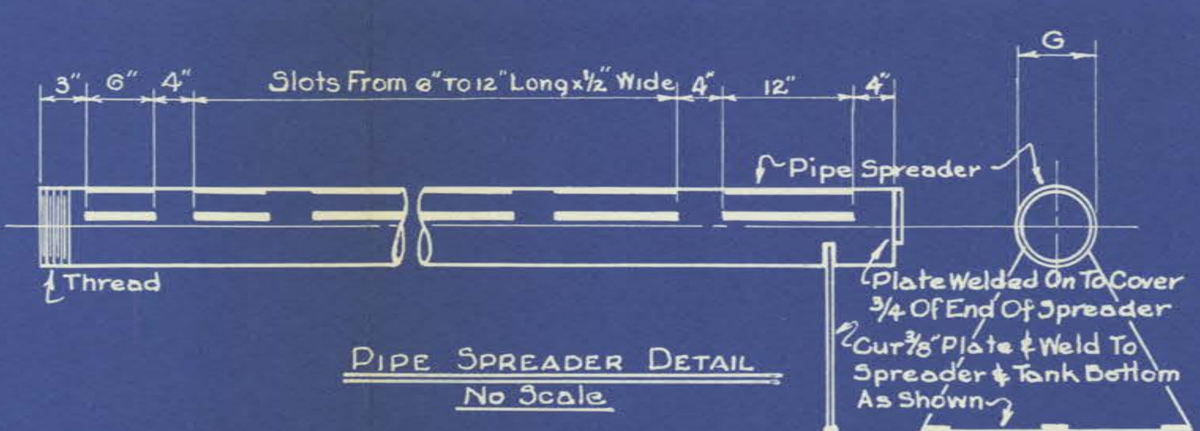
Note! All Valves To Be Nordstrom Plug Valves.



Walkway Lug Details
1/2 Full Size

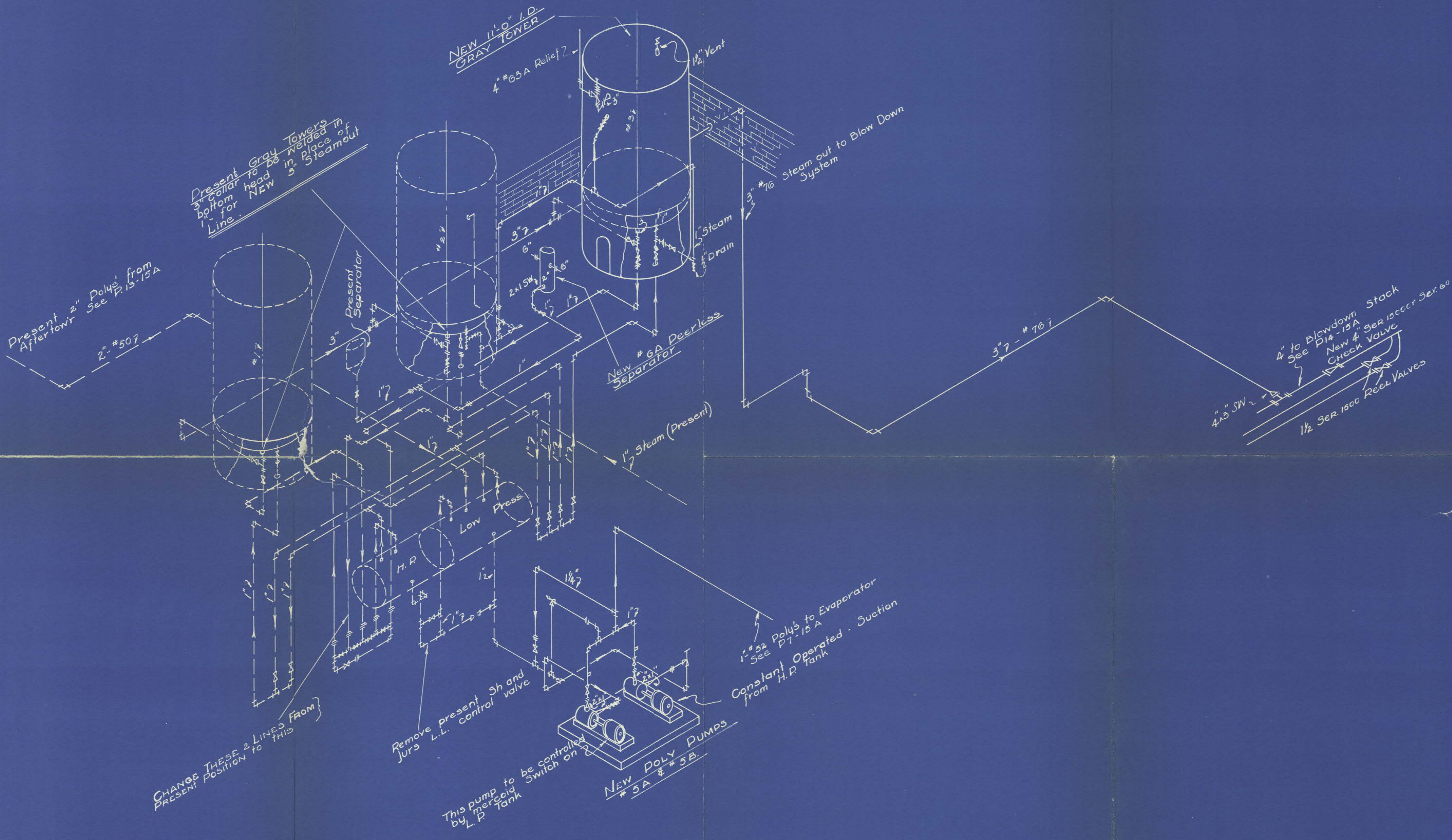


Boot
Sample Cock Detail
No Scale



Pipe Spreader Detail
No Scale

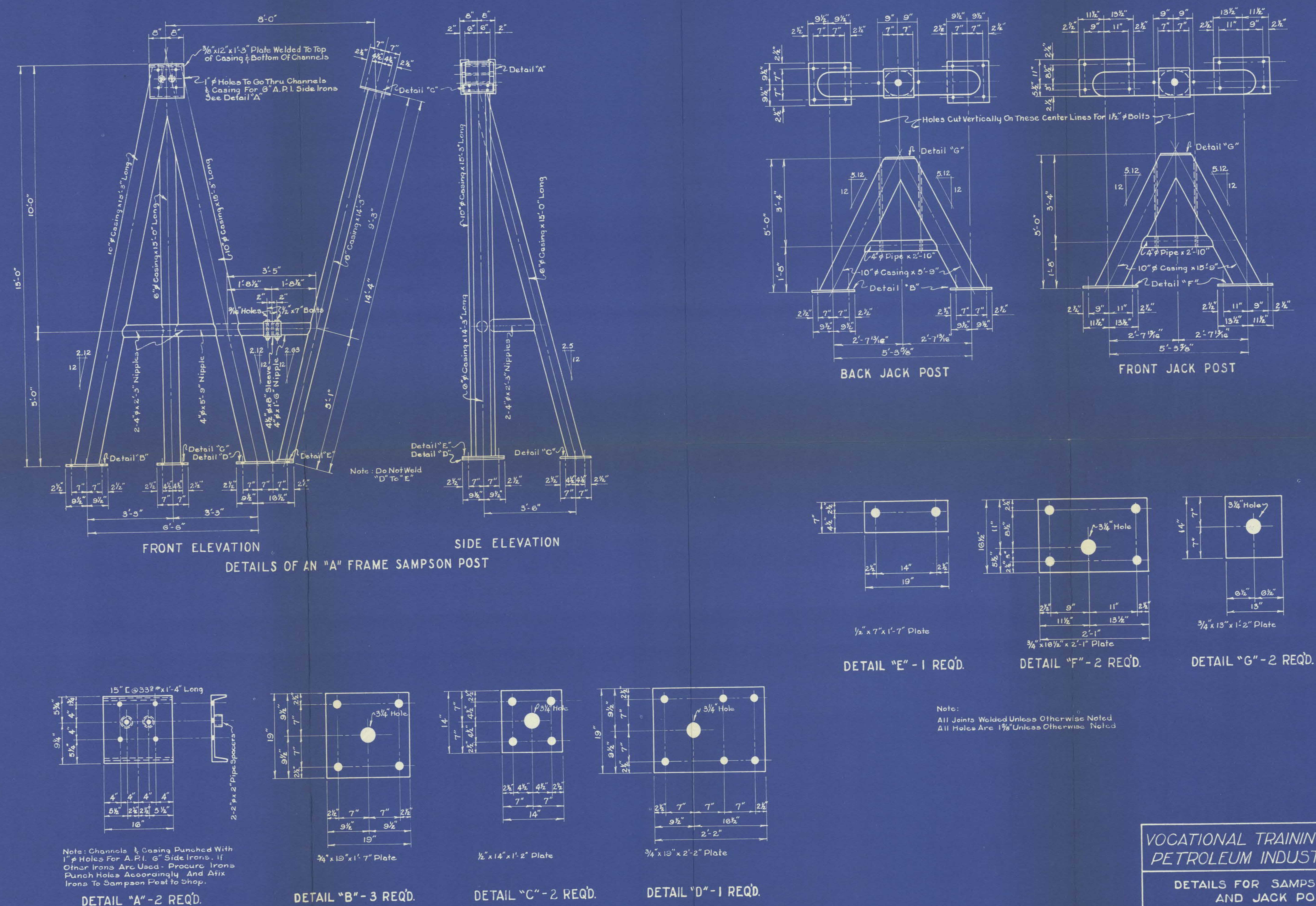
VOCATIONAL TRAINING COURSES PETROLEUM INDUSTRY SERIES	
LEASE TANK BATTERY PIPING WITH OUTSIDE BOOT	
Date 8-7-37 Scale As Shown	BY M.L. POWERS
SHEET 151	



Polymer Piping System

——— = New Pipe & Equipment
— — — = Old " "

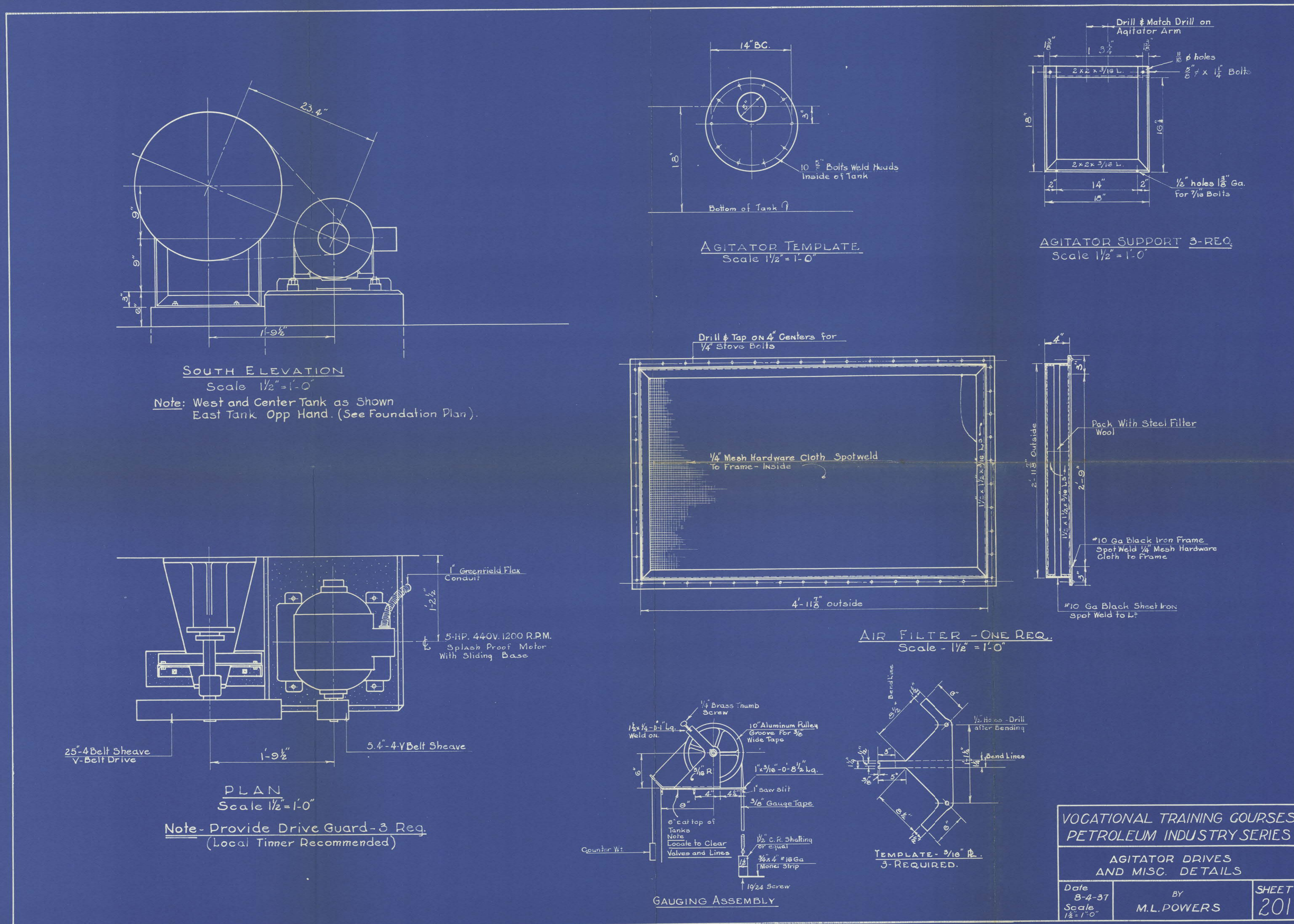
VOCATIONAL TRAINING COURSES PETROLEUM INDUSTRY SERIES		
POLYMER PIPING SYSTEM		
Date 8-15-37 Scale As Shown	BY M.L. POWERS	SHEET 152

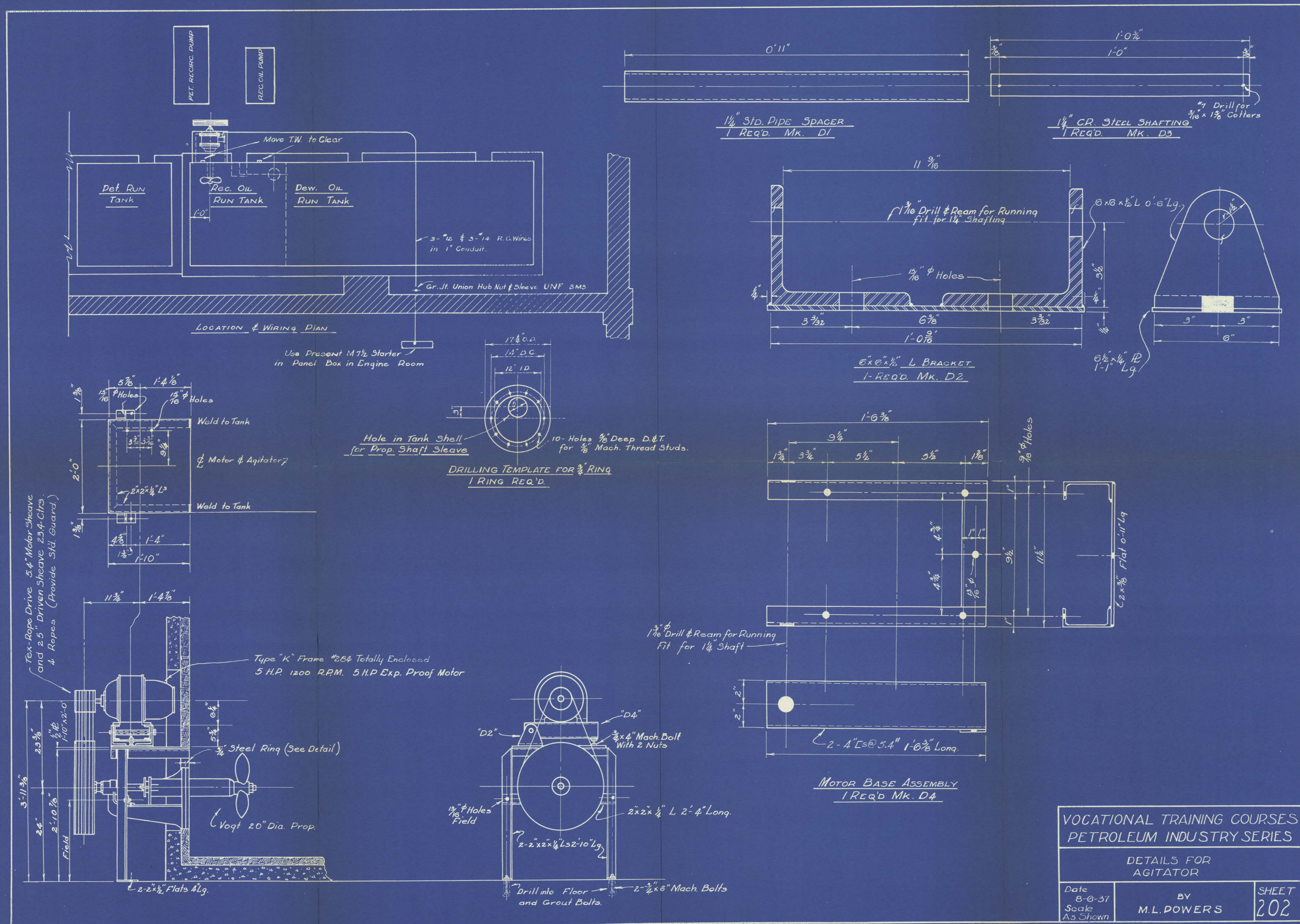


VOCATIONAL TRAINING COURSES
PETROLEUM INDUSTRY SERIES

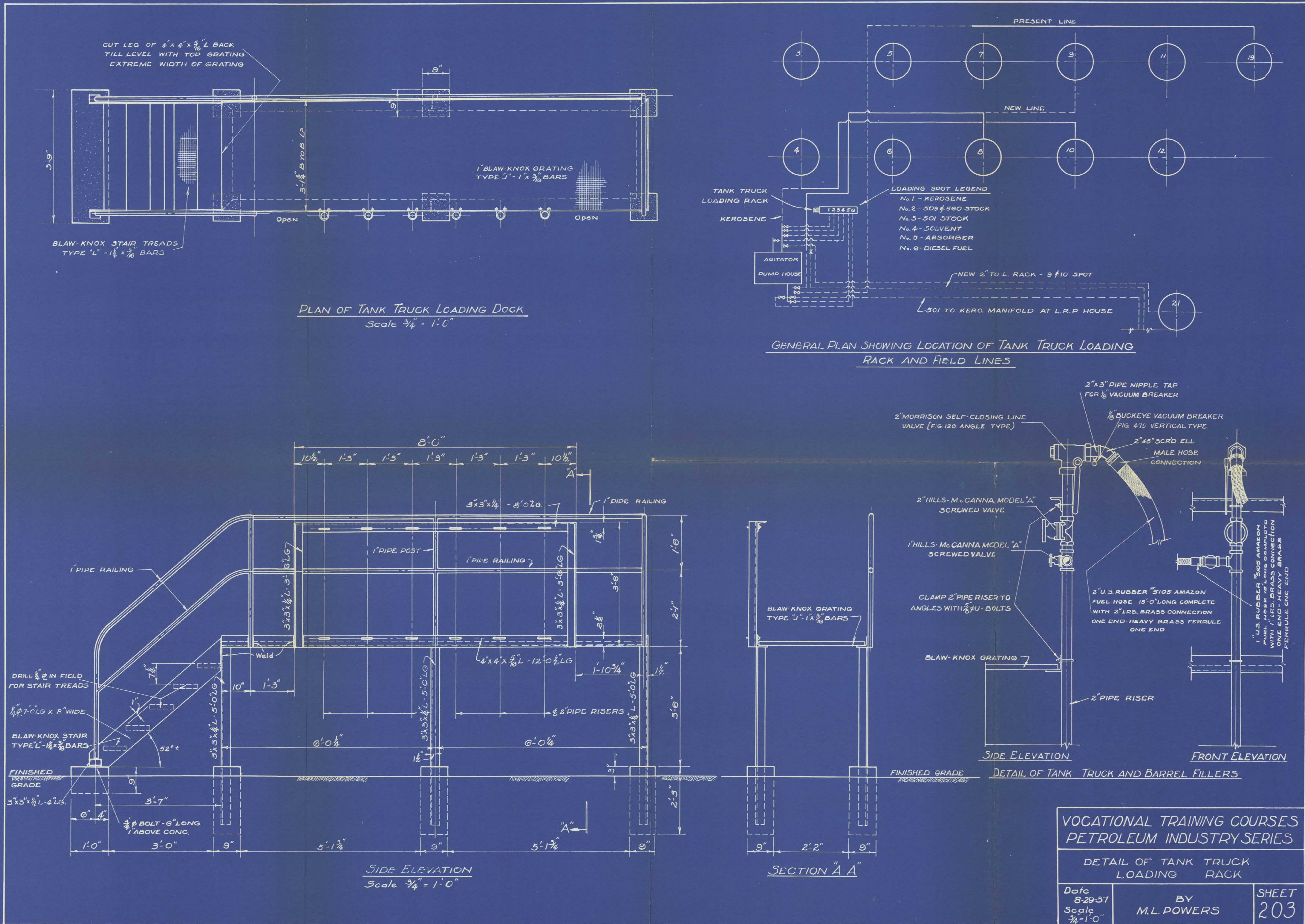
DETAILS FOR SAMPSON POST AND JACK POST

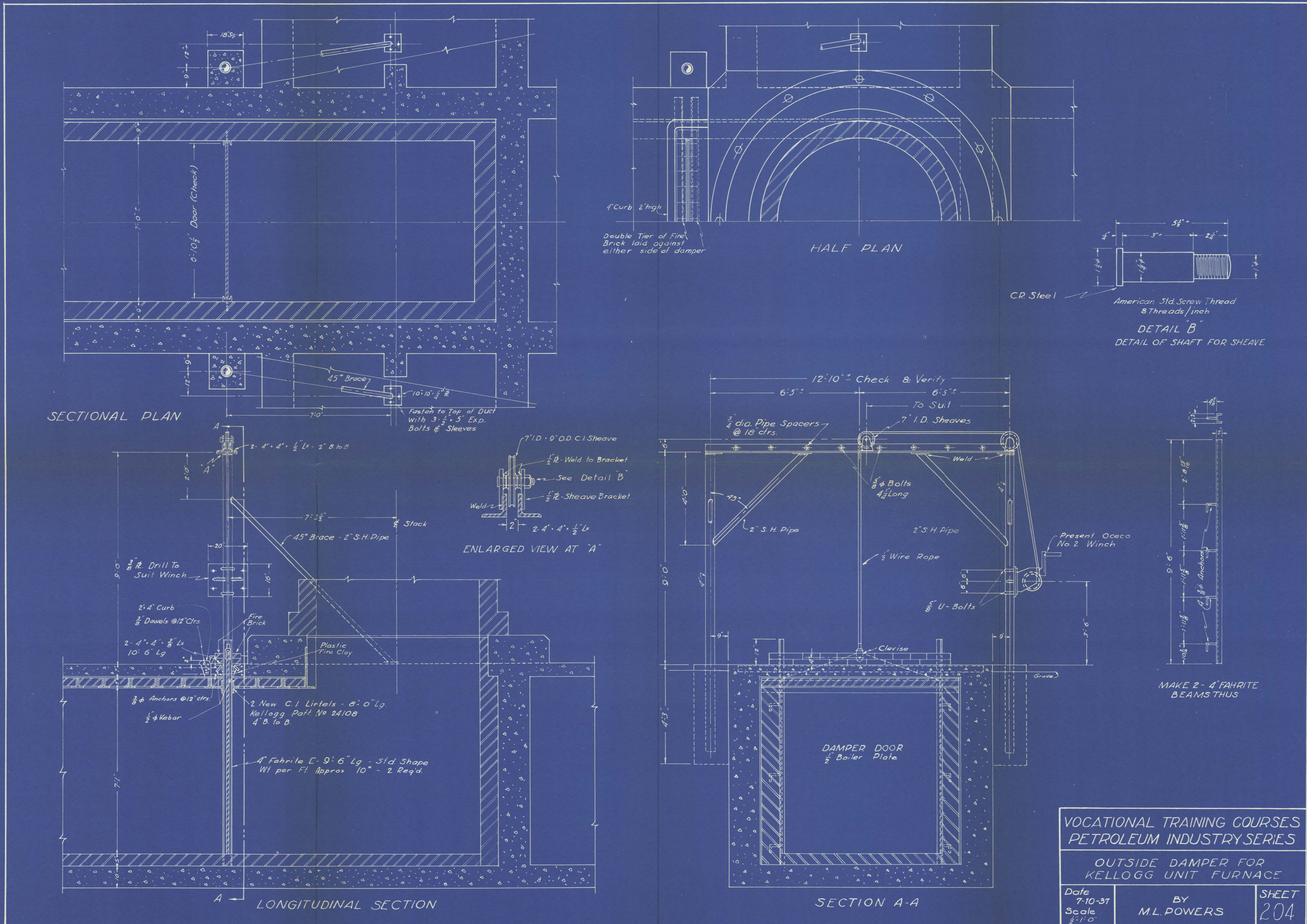
Date 9-14-37 Scale As Shown	BY M.L. POWERS	SHEET 153


23.4"
9"
9"
3"
6"
1'-9½"
South Elevation
Scale 1½" = 1'-0"
Note: West and Center Tank as Shown
East Tank Opp Hand. (See Foundation Plan).
1" Greenfield Flex Conduit
1'-2½"
5-HP. 440V. 1200 R.P.M.
Splash Proof Motor
With Sliding Base
25"-4 Belt Sheave
V-Belt Drive
1'-9½"
5.4"-4-V Belt Sheave
Plan
Scale 1½" = 1'-0"
Note - Provide Drive Guard - 3 Req.
(Local Tinner Recommended)
14" BC.
3"
18"
10 ⅝" Bolts Weld Heads Inside of Tank
Bottom of Tank
Agitator Template
Scale 1½" = 1'-0"
Drill & Match Drill on Agitator Arm
1 3½
11/16 ø holes
⅝" ø x 1¼" Bolts
2x2x3/16 L.
18"
16¼"
2" 14" 2"
18"
½" holes 1⅜" Ga. for 7/16 Bolts
Agitator Support 3-Req.
Scale 1½" = 1'-0"
Drill & Tap on 4" Centers for ¼" Stove Bolts
¼" Mesh Hardware Cloth Spotweld To Frame - Inside
1½ x 1½ x 3/16 L's
4'-11⅞" outside
4"
3"
2'-11⅞" outside
2'-9"
Pack With Steel Filter Wool
#10 Ga Black Iron Frame
Spot Weld ¼" Mesh Hardware Cloth to Frame
#10 Ga Black Sheet Iron Spot Weld to L's
Air Filter - One Req.
Scale - 1½" = 1'-0"
¼ Brass Thumb Screw
1½x¼-0-1" Lg. Weld on.
10" Aluminum Pulley Groove for 3/8 Wide Tape
1"x3/16"-0-8½" Lg.
1" Saw slit
3/8" Gauge Tape
3/16 R
6"
8"
4"
4½"
6" c at top of Tanks
Note
Locate to Clear Valves and Lines
½" C.R. Shafting or equal
3/8"x4" #18 Ga Monel Strip
1 9/24 Screw
Counter Wt.
Gauging Assembly
Bend Line
½" Holes - Drill after Bending
Bend Lines
6"
8½"
5"
Template - 3/16" ℞.
3-Required.
Vocational Training Courses
Petroleum Industry Series
Agitator Drives
and Misc. Details
Date 8-4-37
Scale 1½ = 1'-0"
By M.L. Powers
Sheet 201



1¼" Std. Pipe Spacer
1 Req'd. Mk. D1
1¼" C.R. Steel Shafting
1 Req'd. Mk. D3
#7 Drill for 3/16" x 1⅜" Cotters
1 3/16" Drill & Ream for Running Fit for 1¼ Shafting
15/16" ϕ Holes
6x6x½" L 0'-6" Lg.
6½" x ¼" ℞ 1'-1" Lg.
6"x6"x½" L Bracket
1-Req'd. Mk. D2
Pet. Recirc. Pump
Rec. Oil Pump
Move T.W. to Clear
Pet. Run Tank
Rec. Oil Run Tank
Dew. Oil Run Tank
3-#12 & 3-#14 R.C. Wires in 1" Conduit.
Gr. Jt. Union Hub Nut & Sleeve UNF 3MS
Location & Wiring Plan
Use Present M 7½ Starter in Panel Box in Engine Room
Weld to Tank
℄ Motor & Agitator
Hole in Tank Shell for Prop. Shaft Sleeve
10-Holes 5/8" Deep D.&T. for 5/8" Mach. Thread Studs.
Drilling Template for ¾" Ring
1 Ring Req'd.
1 3/16" ϕ Drill & Ream for Running Fit for 1¼" Shaft
2-4" ⊏s @ 5.4# 1'-6⅜" Long.
2x3/16" Flat 0'-11" Lg
9/16" ϕ Holes
Motor Base Assembly
1 Req'd Mk. D4
Tex-Rope Drive 5.4" Motor Sheave and 25" Driven Sheave 23.4 Ctrs. 4 Ropes (Provide Std. Guard)
Type "K" Frame #284 Totally Enclosed 5 H.P. 1200 R.P.M. 5 H.P. Exp. Proof Motor
¾" Steel Ring (See Detail)
Vogt 20" Dia. Prop.
2-2x½" Flats 4 Lg.
"D2"
"D4"
¾x4" Mach. Bolt With 2 Nuts
13/16" ϕ Holes Field
2"x2"x¼" L 2'-4" Long.
2-2"x2"x¼" Ls 2'-10" Lg.
Drill into Floor and Grout Bolts.
2-¾"x6" Mach. Bolts
Vocational Training Courses
Petroleum Industry Series
Details for Agitator
Date 8-6-37
Scale As Shown
By M.L. Powers
Sheet 202


CUT LEG OF 4"x4"x5/16" L BACK TILL LEVEL WITH TOP GRATING EXTREME WIDTH OF GRATING
1" BLAW-KNOX GRATING TYPE "J" - 1"x 3/16" BARS
Open
Open
BLAW-KNOX STAIR TREADS TYPE "L" - 1 1/4 x 3/16" BARS
PLAN OF TANK TRUCK LOADING DOCK
Scale 3/4" = 1'-0"
PRESENT LINE
NEW LINE
TANK TRUCK LOADING RACK
KEROSENE
LOADING SPOT LEGEND
No. 1 - KEROSENE
No. 2 - 509 & 580 STOCK
No. 3 - 501 STOCK
No. 4 - SOLVENT
No. 5 - ABSORBER
No. 6 - DIESEL FUEL
AGITATOR
PUMP HOUSE
NEW 2" TO L. RACK - 9 & 10 SPOT
501 TO KERO. MANIFOLD AT L.R.P HOUSE
GENERAL PLAN SHOWING LOCATION OF TANK TRUCK LOADING RACK AND FIELD LINES
1" PIPE RAILING
1" PIPE POST
1" PIPE RAILING
3"x3"x1/4 - 8'-0" LG.
4"x4"x5/16" L - 12'-0 1/2" LG
DRILL 5/8" Ø IN FIELD FOR STAIR TREADS
BLAW-KNOX STAIR TYPE "L" - 1 1/4 x 3/16" BARS
FINISHED GRADE
Weld
℄ 2" PIPE RISERS
3/4" Ø BOLT - 6" LONG 1" ABOVE CONC.
SIDE ELEVATION
Scale 3/4" = 1'-0"
BLAW-KNOX GRATING TYPE "J" - 1"x 3/16" BARS
FINISHED GRADE
SECTION "A-A"
2"x3" PIPE NIPPLE TAP FOR 1/8" VACUUM BREAKER
2" MORRISON SELF-CLOSING LINE VALVE (FIG. 120 ANGLE TYPE)
1/8" BUCKEYE VACUUM BREAKER FIG 475 VERTICAL TYPE
2" 45° SCR'D ELL
MALE HOSE CONNECTION
2" HILLS-McCANNA MODEL "A" SCREWED VALVE
1" HILLS-McCANNA MODEL "A" SCREWED VALVE
CLAMP 2" PIPE RISER TO ANGLES WITH 5/8" Ø U-BOLTS
2" U.S. RUBBER #5105 AMAZON FUEL HOSE 15'-0" LONG COMPLETE WITH 2" I.R.S. BRASS CONNECTION ONE END - HEAVY BRASS FERRULE ONE END
1" U.S. RUBBER #5105 AMAZON FUEL HOSE 18" LONG COMPLETE WITH 1" I.R.S. BRASS CONNECTION ONE END - HEAVY BRASS FERRULE ONE END
BLAW-KNOX GRATING
2" PIPE RISER
SIDE ELEVATION
FRONT ELEVATION
DETAIL OF TANK TRUCK AND BARREL FILLERS
VOCATIONAL TRAINING COURSES
PETROLEUM INDUSTRY SERIES
DETAIL OF TANK TRUCK LOADING RACK
Date 8-29-37
Scale 3/4" = 1'-0"
BY M.L. POWERS
SHEET 203



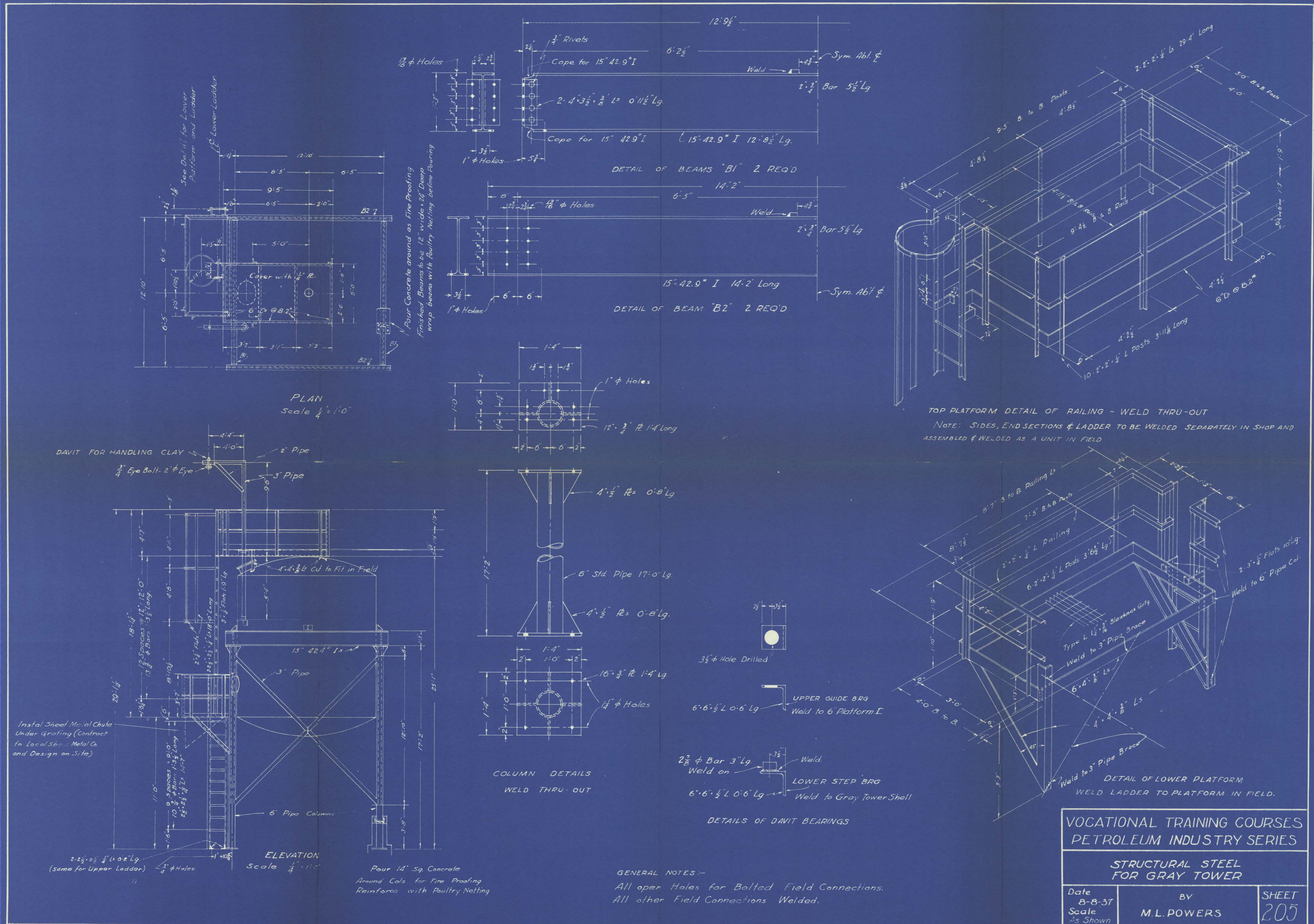
VOCATIONAL TRAINING COURSES
PETROLEUM INDUSTRY SERIES

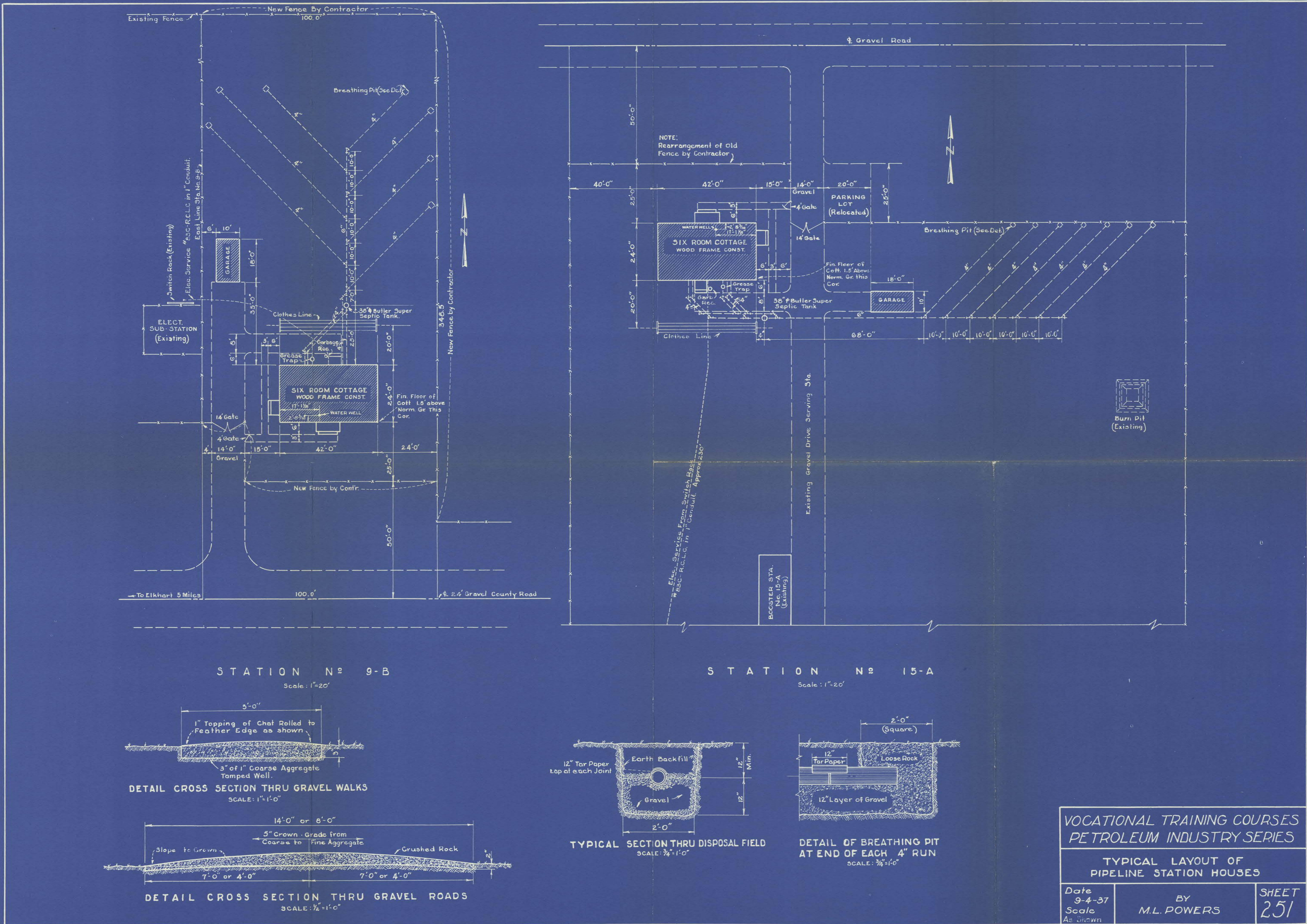
OUTSIDE DAMPER FOR KELLOGG UNIT FURNACE

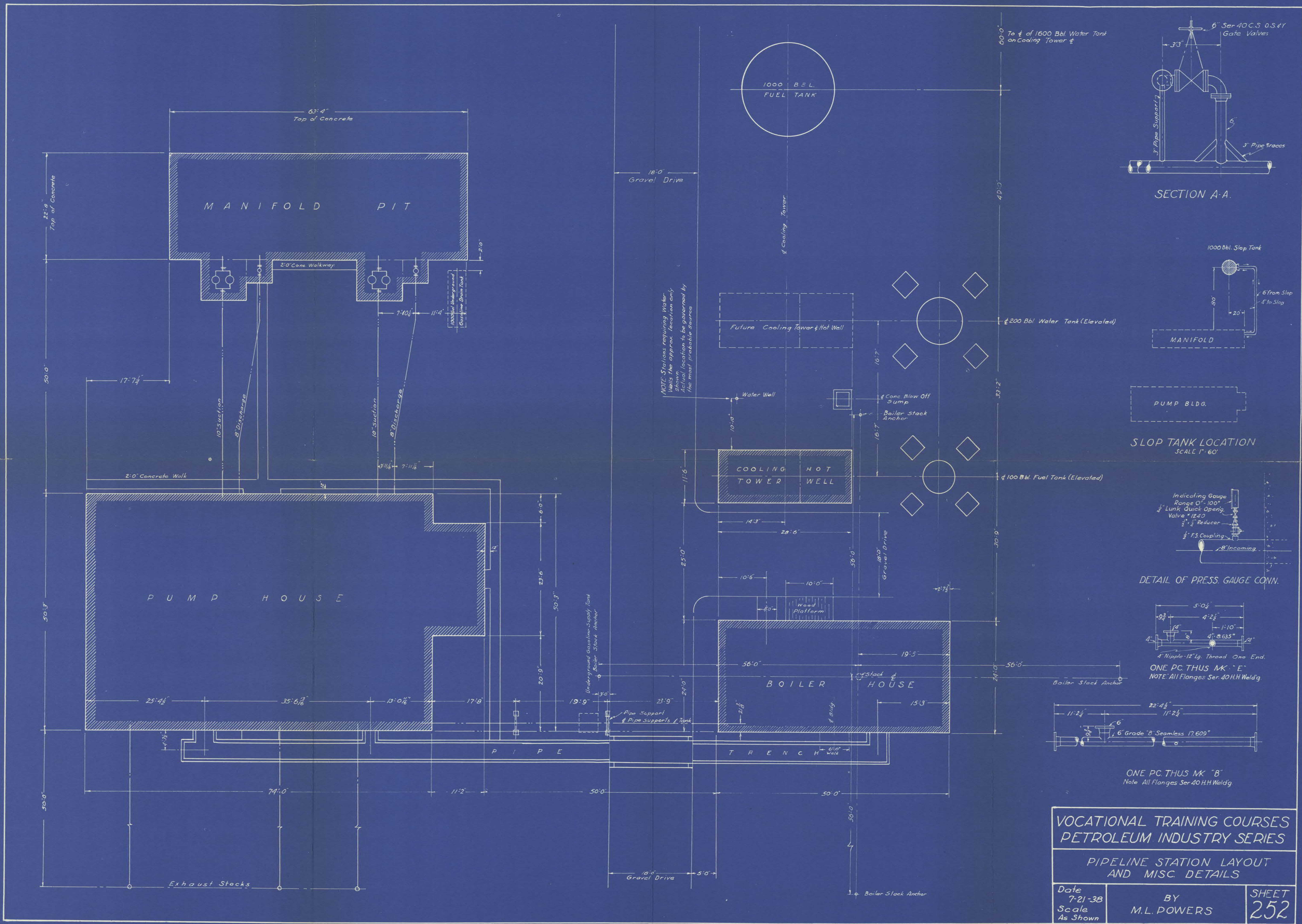
Date 7-10-37
Scale ½"=1'-0"

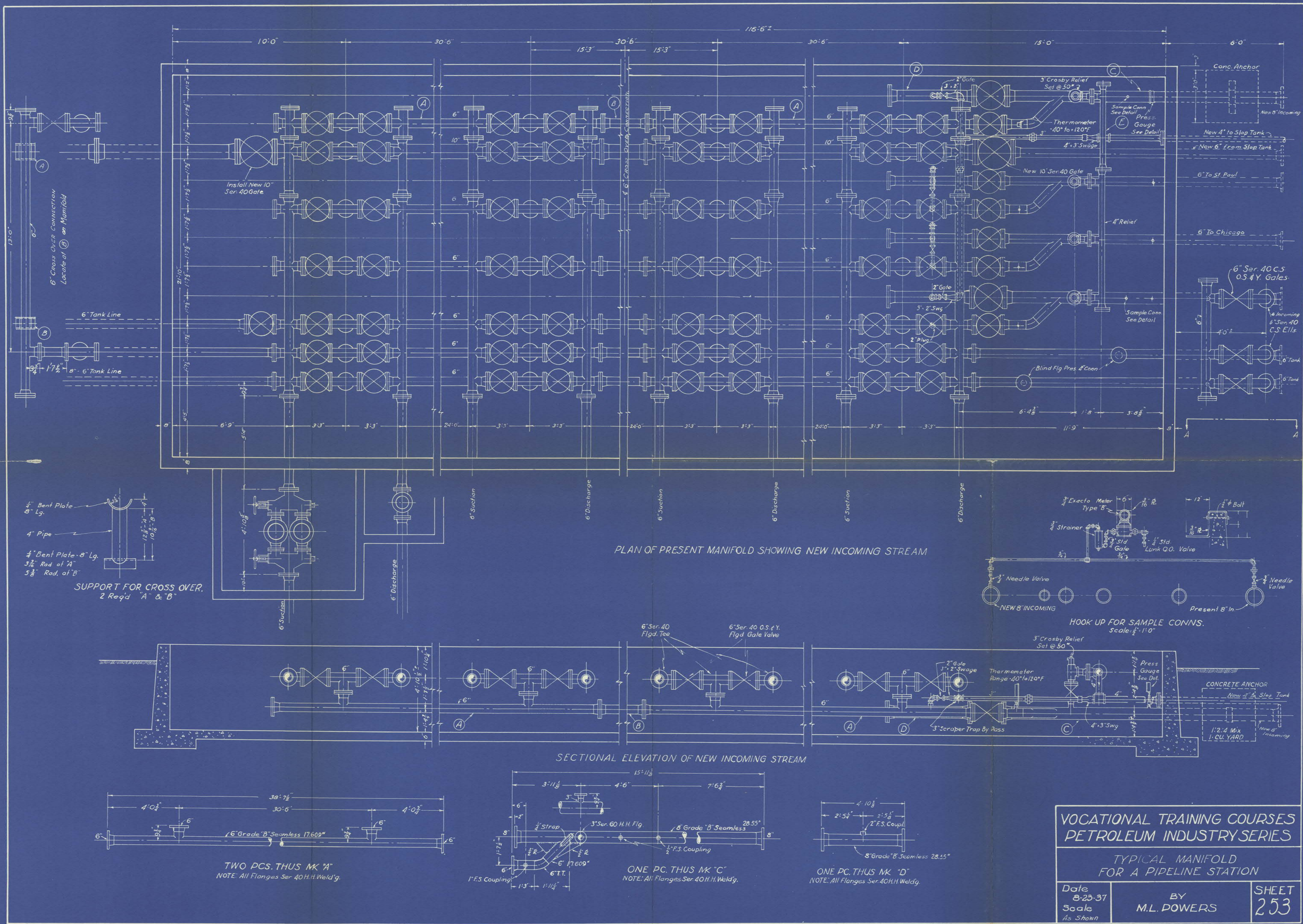
BY M.L. POWERS

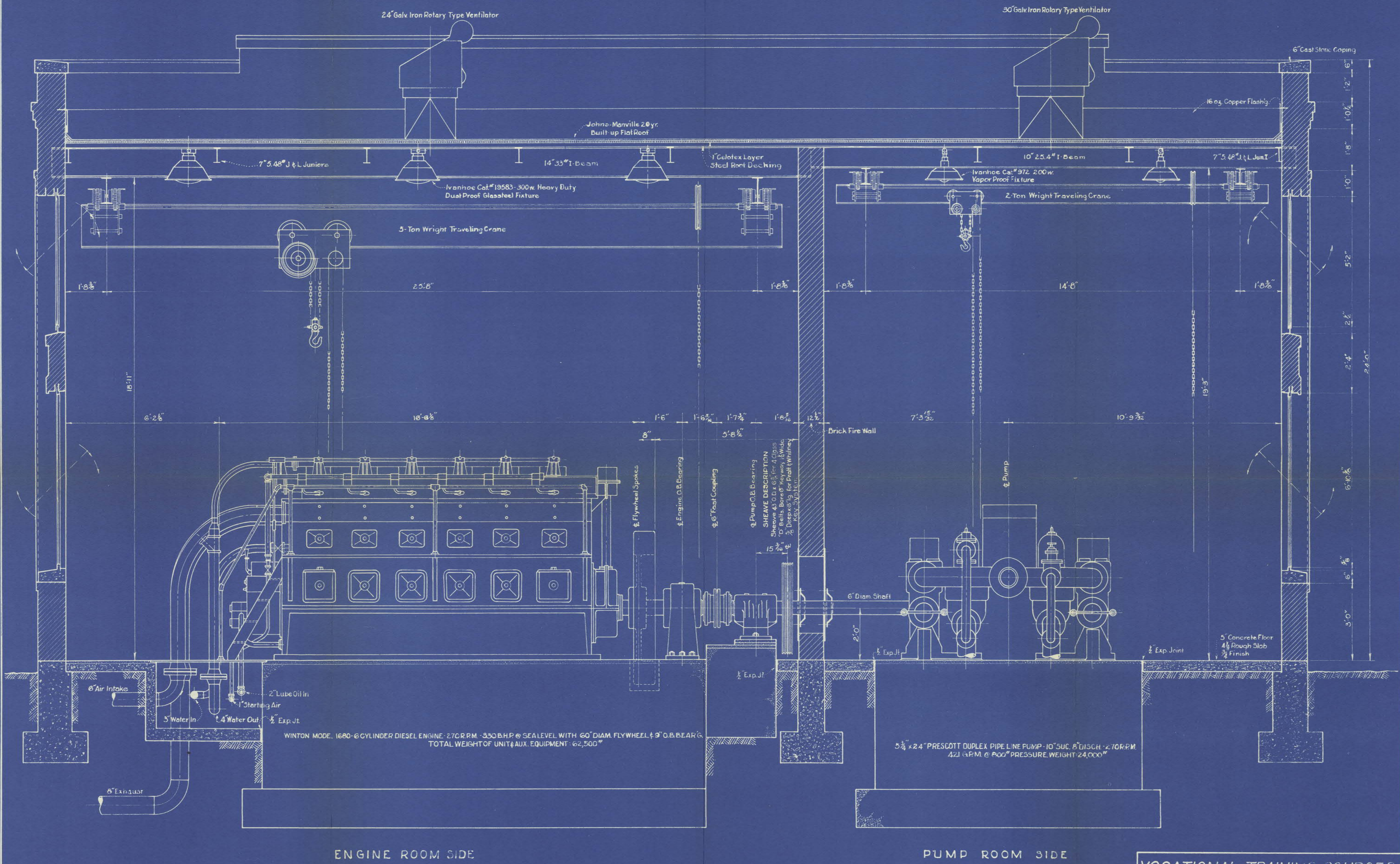
SHEET 204


PLAN
Scale 1/4" = 1'-0"
See Detail for Lower Platform and Ladder
℄ Lower Ladder
Cover with 1/4" R
Pour Concrete around as Fire Proofing
Finished Beams to be 12" wide × 24" Deep
Wrap beams with Poultry Netting before Pouring
13/16" ϕ Holes
3/4" Rivets
Cope for 15" 42.9# I
2-4×3 1/2×3/8 Ls 0'-11 1/2" Lg.
Cope for 15" 42.9# I
15"-42.9# I 12'-8 1/2" Lg.
2×3/4 Bar 5 1/2" Lg
Sym. Abt. ℄
Weld
1" ϕ Holes
DETAIL OF BEAMS "B1" 2 REQ'D
15"-42.9# I 14'-2" Long
DETAIL OF BEAM "B2" 2 REQ'D
12×3/4 R 1'-4" Long
4×1/2 Rs 0'-8" Lg
6" Std. Pipe 17'-0" Lg
4×1/2 Rs 0'-8" Lg.
16×3/4 R 1'-4" Lg
1/4" ϕ Holes
COLUMN DETAILS
WELD THRU-OUT
3 1/2" ϕ Hole Drilled
6×6×1/2 L 0'-6" Lg
UPPER GUIDE BRG
Weld to 6" Platform I
2 3/8" ϕ Bar 3" Lg.
Weld on
6×6×1/2 L 0'-6" Lg
LOWER STEP BRG
Weld to Gray Tower Shell
DETAILS OF DAVIT BEARINGS
DAVIT FOR HANDLING CLAY
3/4" Eye Bolt - 2" ϕ Eye
2" Pipe
3" Pipe
4×4×1/2 Ls Cut to Fit in Field
15" 42.4# Is
3" Pipe
6" Pipe Columns
Instal Sheet Metal Chute Under Grating (Contract to Local Sheet Metal Co. and Design on Site)
(same for Upper Ladder)
ELEVATION
Scale 1/4" = 1'-0"
Pour 14" Sq. Concrete Around Cols. for Fire Proofing
Reinforce with Poultry Netting
GENERAL NOTES:-
All open Holes for Bolted Field Connections.
All other Field Connections Welded.
TOP PLATFORM DETAIL OF RAILING - WELD THRU-OUT
NOTE: SIDES, END SECTIONS & LADDER TO BE WELDED SEPARATELY IN SHOP AND ASSEMBLED & WELDED AS A UNIT IN FIELD
2-2×2×1/4 Ls 29'-4" Long
10-2×2×1/4 L Posts 3'-11 1/8" Long
6" Ls @ B.2"
Railing
Weld to 3" Pipe Brace
2-3×1/4 Flats 10" Lg.
Weld to 6" Pipe Col.
DETAIL OF LOWER PLATFORM
WELD LADDER TO PLATFORM IN FIELD.
VOCATIONAL TRAINING COURSES
PETROLEUM INDUSTRY SERIES
STRUCTURAL STEEL
FOR GRAY TOWER
Date 8-8-37
Scale As Shown
BY
M.L. POWERS
SHEET
205


New Fence By Contractor
Existing Fence
100.0'
Breathing Pit (See Det.)
Switch Rack (Existing)
Elec. Service "#3C-R.C.L.C. in 1" Conduit.
East Line Sta. No. 9-B
GARAGE
ELECT. SUB-STATION (Existing)
Clothes Line
3/8" ø Butler Super Septic Tank.
Garbage Rec.
Grease Trap
SIX ROOM COTTAGE
WOOD FRAME CONST.
WATER WELL
Fin. Floor of Cott. 1.5' above Norm. Gr. This Cor.
14' Gate
4' Gate
Gravel
New Fence by Contr.
348.5
New Fence by Contractor
To Elkhart 5 Miles
℄ 24' Gravel County Road
STATION Nº 9-B
Scale: 1"=20'
℄ Gravel Road
NOTE: Rearrangement of Old Fence by Contractor
PARKING LOT (Relocated)
Breathing Pit (See Det.)
Fin. Floor of Cott. 1.5' Above Norm. Gr. this Cor.
3/8" ø Butler Super Septic Tank
Clothes Line
Existing Gravel Drive Serving Sta.
Elec. Service From Switch Rack #3C-R.C.L.C. in 1" Conduit Approx. 230'
BOOSTER STA. No. 15-A (Existing)
Burn Pit (Existing)
STATION Nº 15-A
Scale: 1"=20'
1" Topping of Chat Rolled to Feather Edge as shown
3" of 1" Coarse Aggregate Tamped Well.
DETAIL CROSS SECTION THRU GRAVEL WALKS
SCALE: 1"=1'-0"
14'-0" or 8'-0"
5" Crown - Grade from Coarse to Fine Aggregate
Slope to Crown
Crushed Rock
7'-0" or 4'-0"
DETAIL CROSS SECTION THRU GRAVEL ROADS
SCALE: 1/2"=1'-0"
12" Tar Paper Lap at each Joint
Earth Backfill
Gravel
TYPICAL SECTION THRU DISPOSAL FIELD
SCALE: 3/4"=1'-0"
2'-0" (Square)
Tar Paper
Loose Rock
12" Layer of Gravel
DETAIL OF BREATHING PIT AT END OF EACH 4" RUN
SCALE: 3/4"=1'-0"
VOCATIONAL TRAINING COURSES
PETROLEUM INDUSTRY SERIES
TYPICAL LAYOUT OF PIPELINE STATION HOUSES
Date 9-4-37
Scale As Shown
BY M.L. POWERS
SHEET 251


MANIFOLD PIT
63'-4" Top of Concrete
22'-8" Top of Concrete
2'-0" Conc. Walkway
1000 Gal. Underground Gasoline Drain Tank
10" Suction
8" Discharge
2'-0" Concrete Walk
PUMP HOUSE
18'-0" Gravel Drive
NOTE: Stations requiring Water Wells the approx. location only shown. Actual location to be governed by the most probable source.
1000 BBL. FUEL TANK
℄ Cooling Tower
Future Cooling Tower & Hot Well
Water Well
Conc. Blow Off Sump
Boiler Stack Anchor
COOLING TOWER
HOT WELL
℄ 200 Bbl. Water Tank (Elevated)
℄ 100 Bbl. Fuel Tank (Elevated)
To ℄ of 1600 Bbl. Water Tank on Cooling Tower ℄
Wood Platform
BOILER HOUSE
Underground Gasoline Supply Tank
Pipe Support
℄ Pipe Supports ℄ Tank
PIPE TRENCH
Exhaust Stacks
Boiler Stack Anchor
6" Ser. 40 C.S. O.S.&Y. Gate Valves
3" Pipe Support
3" Pipe Braces
SECTION A-A.
1000 Bbl. Slop Tank
6" from Slop
4" to Slop
MANIFOLD
PUMP BLDG.
SLOP TANK LOCATION
SCALE 1"-60'
Indicating Gauge Range 0"-100"
½" Lunk Quick Openg. Valve #1240
½"-¼" Reducer
½" F.S. Coupling
8" Incoming
DETAIL OF PRESS. GAUGE CONN.
4" Nipple-12" Lg. Thread One End.
ONE PC. THUS MK. "E"
NOTE: All Flanges Ser. 40 H.H. Weld'g
6" Grade "B" Seamless 17.609"
ONE PC. THUS MK. "B"
Note: All Flanges Ser. 40 H.H. Weld'g
VOCATIONAL TRAINING COURSES
PETROLEUM INDUSTRY SERIES
PIPELINE STATION LAYOUT AND MISC. DETAILS
Date 7-21-38
Scale As Shown
BY M.L. POWERS
SHEET 252


PLAN OF PRESENT MANIFOLD SHOWING NEW INCOMING STREAM
SUPPORT FOR CROSS OVER. 2 Req'd "A" & "B"
HOOK UP FOR SAMPLE CONNS. Scale: 1/2" = 1'-0"
SECTIONAL ELEVATION OF NEW INCOMING STREAM
TWO PCS. THUS MK "A"
NOTE: All Flanges Ser. 40 H.H. Weld'g.
ONE PC. THUS MK "C"
NOTE: All Flanges Ser. 40 H.H. Weld'g.
ONE PC. THUS MK "D"
NOTE: All Flanges Ser. 40 H.H. Weld'g.
VOCATIONAL TRAINING COURSES
PETROLEUM INDUSTRY SERIES
TYPICAL MANIFOLD
FOR A PIPELINE STATION
Date 8-25-37
Scale As Shown
BY M.L. POWERS
SHEET 253



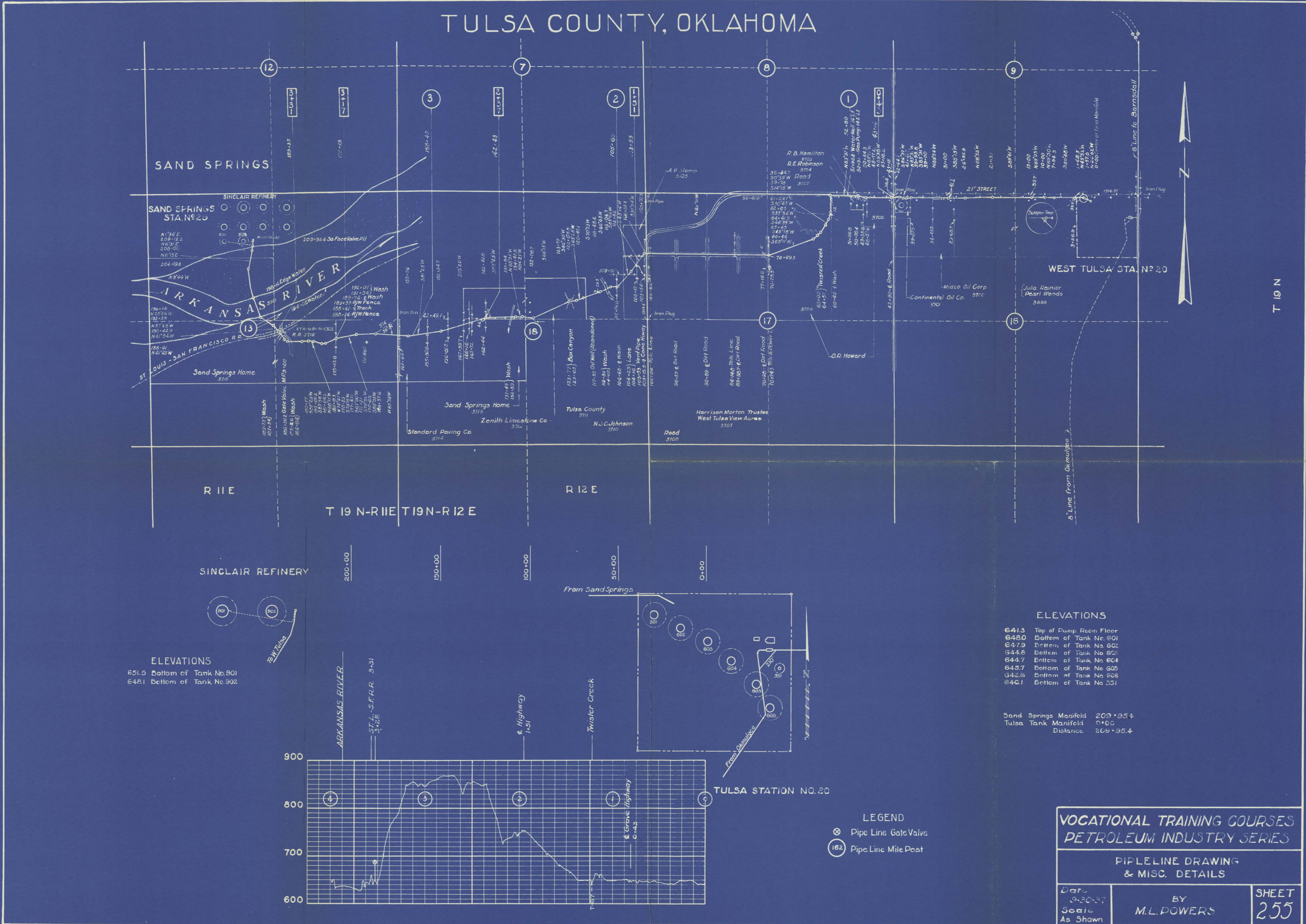
VOCATIONAL TRAINING COURSES
PETROLEUM INDUSTRY SERIES

SECTION THROUGH PUMPING UNIT

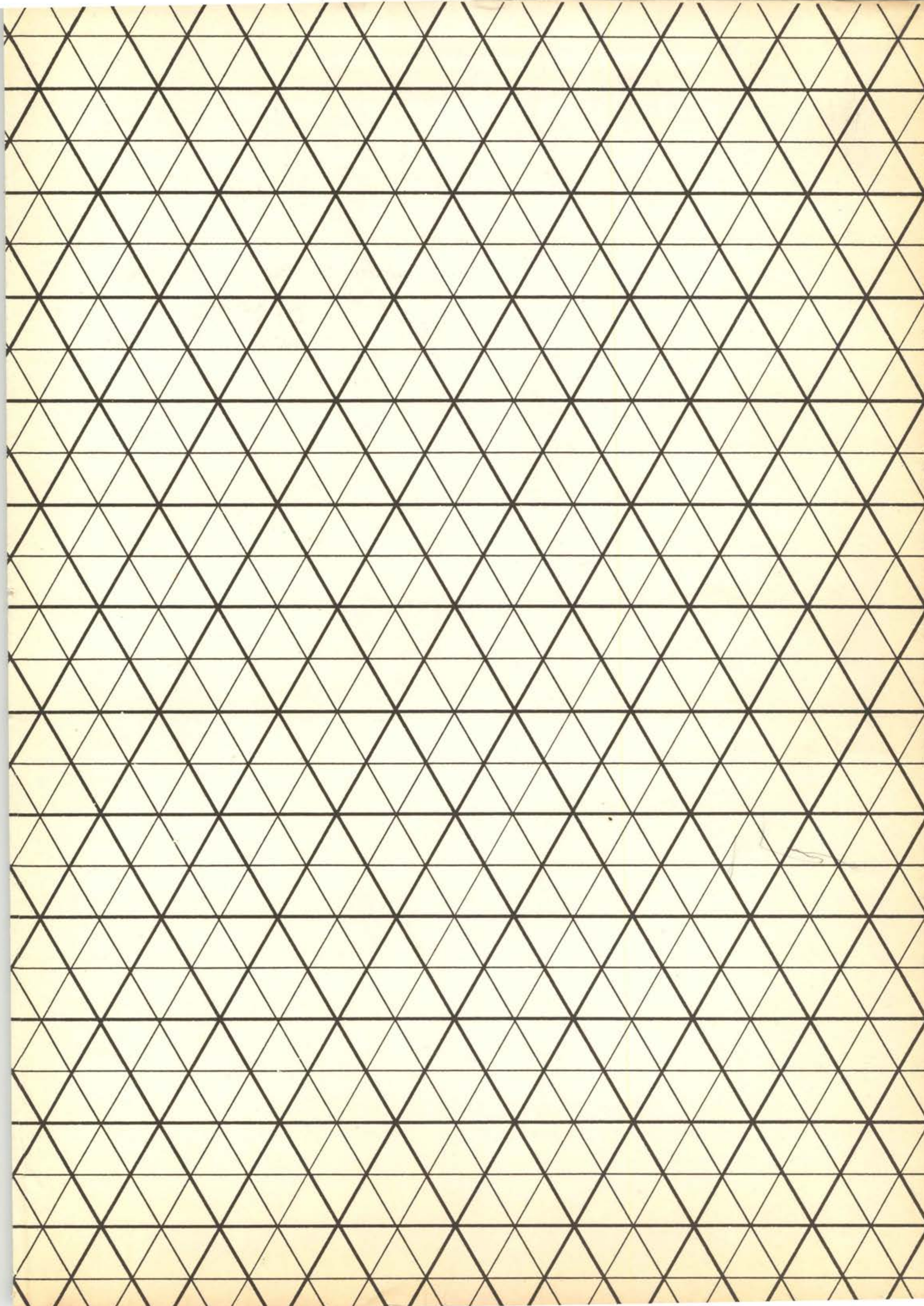
Date 9-28-37
Scale As Shown

By M.L. POWERS

SHEET 254


TULSA COUNTY, OKLAHOMA
SAND SPRINGS
SAND SPRINGS STA. Nº 29
SINCLAIR REFINERY
ARKANSAS RIVER
ST. LOUIS - SAN FRANCISCO R.R.
Sand Springs Home
Standard Paving Co.
Zenith Limestone Co.
Tulsa County
N.J.C. Johnson
Harrison Morton Trustee
West Tulsa View Acres
Road
O.R. Howard
R.B. Hamilton
R.E. Robinson
A.H. Johnson
Continental Oil Co.
Midco Oil Corp.
Julia Rainier
Pearl Wends
WEST TULSA STA. Nº 20
21st STREET
6" Line to Barnsdall
8" Line from Okmulgee
Box Canyon
Twister Creek
T 19 N
R 11 E
R 12 E
T 19 N-R 11 E T 19 N-R 12 E
SINCLAIR REFINERY
To W. Tulsa
ELEVATIONS
651.5 Bottom of Tank No. 901
648.1 Bottom of Tank No. 902
From Sand Springs
From Okmulgee
TULSA STATION NO. 20
ARKANSAS RIVER
ST.L.-S.F.R.R. 3+31
℄ Highway 1+51
Twister Creek
℄ Grove Highway 0+43
900
800
700
600
200+00
150+00
100+00
50+00
0+00
ELEVATIONS
641.3 Top of Pump Room Floor
648.0 Bottom of Tank No. 601
647.9 Bottom of Tank No. 602
644.8 Bottom of Tank No. 603
644.7 Bottom of Tank No. 604
643.7 Bottom of Tank No. 605
642.6 Bottom of Tank No. 606
640.1 Bottom of Tank No. 351
Sand Springs Manifold 209+95.4
Tulsa Tank Manifold 0+00
Distance 209+95.4
LEGEND
Pipe Line Gate Valve
Pipe Line Mile Post
VOCATIONAL TRAINING COURSES
PETROLEUM INDUSTRY SERIES
PIPELINE DRAWING
& MISC. DETAILS
Date 9-30-37
Scale As Shown
BY M.L. POWERS
SHEET 255

WORKING DRAWING PAPER



Mrs. Hazel R. Powers, Typist.