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THE UNION PACIFIC COAL COMPANY
CODE OF STANDARDS

To Govern Safety Work, Including Construction and Operation

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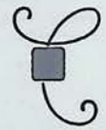

Book No. 236

CODE OF STANDARDS

Standards to Govern Safety Work, Including Construction and Operation

The instructions contained herein, the result of extended and careful study, are deemed those best adapted to govern under the conditions that obtain in the operation of the Company's mines.

Copies of these instructions will be placed in the hands of all men responsible for the safe and proper conduct of the property.

Those receiving copies will be expected to thoroughly familiarize themselves with these instructions. Any variation or exceptions thereto will be permitted only upon specific authority of the General Manager, the Chief Electrician or the Safety Engineer. It will be the duty of Superintendents, Foremen and others in charge of construction or operating matters to comply with these rules, and to so instruct all employes under their supervision.

The chapter "Major Disaster" has been printed on red paper to facilitate quick reference thereto, and should be kept in mind at all times.

For convenience in reference and revision, this book has been separated into chapters, and a marginal and a general index have been provided. Coal mining practice should and will change, making further revision of established standards necessary.

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Vice President - Operation

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Approved:
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President.

PERSONAL CONDUCT

The work of mining coal constitutes a reputable business—providing that the men who work in and about the mines maintain a proper measure of responsibility, good character and self respect. This rule applies to the working force—to the directing force it applies double.

There has always been a close relationship between the work of moving trains and the mining of coal. Both tasks call for men of good, robust physique, alert minds, and a high order of physical courage. Both occupations are in the hazardous class. At one time the chances for death or disability were about equal in the two industries. Within the past 30 years the railroad industry has been made one of the safest industrial occupations—the coal mining industry has made some improvement, but yet is among the higher bracket of accidents per man-hours of exposure. Personal conduct and the existence or the absence of an adequate sense of responsibility enter heavily into the mine accident rate.

The conditions surrounding the operation of the properties of The Union Pacific Coal Company fully justify the belief of the management—

First—That the overwhelming majority of its employes believe in the observance of all Federal, State and Municipal laws, and in maintaining a general high standard of personal conduct.

Second—That the existence of gambling houses, illegally and improperly operated saloons, or other places where intoxicating liquors are sold, or where other forms of vice are carried on or allowed, is definitely wrong, working a serious injury to those who participate in same as well as the younger people of our communities.

Third—That a job that is worth having is worth keeping, and that the obligation on the part of the employe to render a conscientious, continuous service is equally binding with the obligation of the employer to pay an adequate wage, to make the work as safe as possible, and in a general way to look after the welfare and the happiness of his employes, this without attempting in any way to interfere with their lawful privileges.

Believing, as we do, that it is only the few who do not by preference maintain a reasonable standard of conduct, then it reasonably follows that this minority who prefer to go their own way should undertake to ex-

ercise the license they desire elsewhere, finding residence and employment in a more congenial atmosphere.

In making this presentation it will be understood that employes occupying official positions, or in any way charged with the direction of the property or the working force, have a double responsibility in the direction of good conduct, of courtesy to other employes, and in the full observance of all lawful regulatory measures.

MANAGEMENT OF MEN

The greater portion of the contents of this Code of Standards relates to questions of Safety, the reduction of accidents. Possibly more should be said relative to the reduction of mine costs, but we have looked upon Safety as of paramount importance. During the year 1946 The Union Pacific Coal Company's mine cost was 74 per cent mine labor. The salaries of general officers are not included in this computation. In no other industry does man-power enter to the extent that it does in the coal industry. The percentage set forth above certifies to this fact.

A company or corporation has been defined as "an artificial person organized to transact business," which finds expression through its official staff. In so far as the safety of employes is concerned, such rests jointly with the workers and the staff. Assuming the official staff is well chosen and competent, what are our responsibilities toward the workmen?

In recent years the world, through the development of steam and electric power, and through the application of scientific engineering methods, has become a much more prolific mother, and, removed from the distressing conditions that long prevailed, a broader and more equitable attitude has been developed between employer and employe.

An unwilling worker is always a poor worker; his thoughts invariably run to his pay check and the invention of an excuse to avoid even reporting for work; the task he is set to do is loathsome; pride of accomplishment and craftsmanship is invariably lacking with this class of employe. In substance, a cheerful attitude of mind is necessary for the safe and successful accomplishment of any task, and such is an absolutely necessary requirement for successful foremanship. A foreman who cannot see in every employe who comes under his charge a human being who is entitled to fair and just treatment is lacking, and the deficiency will be reflected, not only in mine costs and output, but to an even greater extent in safety.

The matter of giving proper instructions to old as well as new employes is one of vital importance. We all need the service of teachers. Too frequently too much is taken for granted by foremen who assume that the man knows just what he is expected to do and how he should do it. Perhaps more unfortunate impressions are gained by men from this cause than from any other

they are subjected to. The loss is too often a cumulative one in that many men do many similar tasks in as many improper ways, the foreman, for want of immediate contact, losing the opportunity for self-improvement that he might otherwise obtain. No parent ever set a copy line for a child without receiving a corresponding benefit to his or her own handwriting. There is so much in the work of timbering, tracklaying, drilling for shots, the handling of electric connections, machinery, etc., that it is distinctly unfair to let a new man work out his own salvation. Not only should the foreman explain the best method, but he should go with the man, seeing that the best method is put into practice. If the employe comes from another field and has a better method, then this better method should be adopted and made the general practice, adding to the welfare of all the men as well as the property.

Courtesy is an unfailing source of power. Many men object to being told to do a thing in a rough, commanding tone of voice. Such are frequently the very best men, and they will respond cheerfully to a more considerate approach. Men can no longer be induced to give loyal service through fear, and discharging a man for trivial causes is unfair; it savors of cowardice. Men are not given capital punishment for petty offenses; admonishment and advice will go further in the majority of cases. It is only the persistent and flagrant offender who should be dismissed, and he should be taken out for his own good and that of the men who work with him. It should ever be borne in mind that a new man must be found for each one leaving the service, and it costs a material sum to train a new man. Even in this day of relative prosperity, the feeling that a man's position is safe continues to be the greatest gift that the employer can offer. Such supposes safety in the task of building a home, in planning for the education of children and the accumulation of savings.

This company wants the friends and relatives of employes in the service, but the greatest kindness an official can do those who are related to him is to give them a chance to develop their worth under some other official of the company. Many poor men are kept in position throughout the industrial world by favoritism, and an equally large number of good men are handicapped, their independence and initiative destroyed by working for their relatives. As the sons of employes and officials grow up, opportunity for service should be given them under men who will be free to judge them on merit alone.

Sickness absorbs about two per cent of the time of

workers, or approximately four days per year. That men should wilfully absent themselves from a task that only exacts, on an average, 224 days out of 365 suggests, when taken at the best, an indifferent interest in their work and their own individual welfare. This company is making a definite effort to make all positions as permanent as possible. The industry is, at the best, seasonal and when the Railroad, which is our only customer, is called upon to move a heavy short season perishable crop movement, the mines are called upon for more coal, and it is then that every man who possibly can should stay at his task.

In conclusion, a word relative to grievances will not prove amiss. It has been truthfully said that, "when workers present grievances for settlement, it does not always follow that what they ask for is what they really want." Too frequently the presentation of a complaint is merely an attempt to find expression for a condition perhaps far remote from the question raised.

Almost invariably there is a foundation of fact back of every complaint, perhaps a condition which if corrected, would save many dollars for the property. When a complaint is made, foremen and superintendents should exhaustively develop what is in the employe's mind, and, if he is wrong, the employer cannot go too far in explaining the whole situation to him. Too frequently a refusal to investigate a complaint is made when a careful looking into the case, perhaps a few measurements or a time study made by an engineer, would clarify things and make happy the complainant. There is nothing about the mining business that need be concealed, and the great majority of workmen will feel a greater sense of partnership if they are told the reason for action taken. Each foreman should make up his mind that the man who best manages himself can best manage others.

POWER PLANT

Care of Electrical Equipment

The following rules shall govern the operation of electrical equipment at the Power Plant:

Chief Operator.

1. A Chief Operator shall be in charge.

2. Conditions beyond the control of the Chief Operator shall be reported to the Chief Electrician or the Master Mechanic.

Overload.

3. To relieve an overload condition, shift operators shall use their discretion regarding load to be dropped, reporting same to Chief Operator.

Switches Out of Order

4. Switches that trip out due to overload or short circuit must not be closed until a five-minute period has elapsed. Any switch tripping out two successive times shall be allowed to remain out, and it shall be the duty of the shift operator to hang an "Out of Order" sign on switch lever and report same to the Chief Operator.

Entries in Log.

5. The time of opening and closing all switches shall be entered on the log sheet.

Circuit Interruptions.

6. Circuit interruptions lasting more than five minutes shall be reported to the Superintendent and General Manager, or, in their absence, to the Vice President, Operation.

Trouble.

7. Trouble originating at any district, inside or outside the mine, causing switches to trip at the Power Plant, shall be reported to the Chief Operator as soon as possible.

8. During periods of severe electrical disturbances, the district electrician will assign a reliable employe to a local phone, who will remain in contact with the power plant until such time as it is deemed that the emergency has passed.

Inspection of All Equipment, Report of.

9. The Chief Electrician will make a thorough inspection of all electrical equipment not less than once each week, and make a written report to the Vice President, Operation once each month.

HIGH-TENSION LINES

Location.

1. A plan showing location, connections and number of each high-tension switch shall be posted at all stations or sub-stations.

Number.

2. The number of each switch, or group of single-pole switches, shall be displayed in a conspicuous place.

Opening and Closing Switches.

3. The opening and closing of all high-tension switches shall be directed by the Chief Operator.

Record Kept.

4. A record shall be kept of the person directed to open or close high-tension switches. He shall report to the Chief Operator after switches are opened or closed.

Work on High-Tension Lines.

5. When it is desired to work on any high-tension line, the Superintendent of the district involved shall obtain authority to do so from the General Manager, who will issue the necessary instructions.

Requests to Work.

6. Requests to work on high-tension lines shall include the following information:

A. Hours of day during which the work is to be done.

B. Time required to do the work.

C. Nature of the work.

D. Workman in charge, who will communicate with Chief Operator to order line "off." Party ordering line "off" shall be the one to order same "on," unless definite arrangements are made previously.

Drop Load.

7. Before opening high-tension switches, the load shall be dropped by opening distribution switches at the sub-station.

"Live" Lines.

8. No attempt should be made under any circumstances to handle, work on, or repair high voltage lines underground while they are alive or energized. No attempt should be made to work on D.C. lines or low voltage A.C. lines except in an emergency, and then only when proper tools and equipment are available, and under the personal supervision of the Chief Electrician or Machine Boss.

Work on high tension lines on the surface shall only be attempted when the proper equipment and tools are available, and under the direct supervision of the Chief Electrician and Foreman, who in turn will have the permission of the Vice President-Operation, or the General Manager.

Ground Line Before Working On Same.

9. Before any work is done on high-tension lines, the three wires shall be short-circuited and grounded after line is reported "dead" by Chief Operator. Ground chains should be attached to a rod driven into soft earth before same are drawn over a high-tension line. Ground chains should be handled with a rope or dry sticks when in contact with the line.

Ground Chain Removed.

10. When ordering a line "on," the workmen shall advise the Chief Operator that the ground chain, or "short," has been removed.

CARE OF BOILERS AND RELATED EQUIPMENT

Boiler-room equipment is designed and furnished to meet specific economic requirements. Inasmuch as the ultimate results obtained from a steam generator or boiler depend largely upon the care of the unit and the efficient operation of the same, it is necessary that certain rules be followed and records kept of steam generated and fuel used. To burn the fuel efficiently, it is necessary to record temperatures, analyze flue gases and observe regularly the physical condition of the unit to correct any change as it may occur. To detect these changes properly, a Daily Record Sheet must be kept, showing the high and low readings at least once each shift, for all measuring devices on all essential apparatus.

With present-day trends to higher pressures and temperatures the man we formerly knew as a fireman will be termed a boiler operator, and he must acquire a knowledge of the operation of the modern equipment and be familiar with the use of such recording and indicating instruments as are used in steam generation.

A given set of rules would not apply for all types of boilers, so each individual plant should have a set of Operating Standards which should be closely followed.

Placing Boiler In Service.

1. In placing a boiler in service, authority must first be obtained from the person in direct charge. All "Danger" or "Out of Service" signs must be removed. The setting must be examined to ascertain if all doors close properly, and, in the case of pulverized fuel, that the explosion doors are free. All vents to steam space must be opened and superheater drains opened wide. The water in the boiler must be at the normal operating level. The operator must satisfy himself that all valves on pressure gauges and water columns are in their proper positions (open or closed, as the case may be) and be sure, by trial of feed valves and feed-water regulator, that water can be put into the boiler.

Gauges, etc.

2. As steam pressure rises, all gauges and other operating appurtenances must be observed to see that they are functioning properly, and drains and vents must be closed as instructed for the particular type of boiler. The drain from the superheater outlet must be left wide open until the boiler is on the line, when it may be closed. As the water level in the column rises, due to expansion of heated water, it must be closely watched and the boiler blown down, if necessary, to prevent water from being carried over into the superheater and steam main. All connecting pipes between the auto-

Water Level Rising.

matic non-return valve and the main header valve which may contain water should be equipped with drains and these drains opened. The superheater must be kept clear of water and not be subjected to excessive temperatures while boiler is being brought up to line pressure.

Slow Fire.

3. Boilers should be brought up to the line pressure with a slow fire, allowing the brickwork and metal surfaces opportunity for uniform distribution of heat. In emergencies a boiler is sometimes placed in service as quickly as possible, but, whenever time is available, this should not be done.

Non-Return Valves.

4. Automatic or non-return valves are placed on the main steam outlet from a boiler primarily for the purpose of preventing a flow of steam from the main steam line back into a boiler in case of a ruptured tube or surface. When using such a valve as a cutting-in valve, the stem should be raised slightly so that pressure will equalize when line pressure is reached and the valve can then be fully opened. A sticky valve may delay opening until a pressure greater than that in the line has been generated and, in the case of a fully raised stem, the valve could go from a closed position to wide-open position with destructive force.

Care of Boiler in Service.

5. While the boiler is in service, it must be regularly cleaned of ash and soot. Safety valves should be tried each week, either by raising steam pressure, or by gentle pressure on the lever. Boiler must be blown down regularly, the frequency and amount determined by an analysis of the water from the boiler. When the water is chemically treated for such use and the boiler is equipped with continuous blow-down, the main blow-off valves should, once each twenty-four hours, be opened enough to be sure that the valves are in good operating condition. Blow-downs should be made at periods of low load and, if the gauge glass cannot be seen from the blow-off valve, an attendant should be so stationed that he may signal when the proper amount has been blown.

Water Level, Maintenance of.

6. In a distinct case of low water caused by some unforeseen condition when the cause is not at once apparent, the fire should be put out in the quickest possible manner and the Chief Operator notified at once. Gauge glasses and water columns should be blown at least once each shift. The illumination shall be such that the water level can be readily seen. As any leakage at the water columns may cause a false level to be shown, these must be in good condition at all times.

Fuel Supply and Lighting Equipment.

7. The boiler operator must satisfy himself that he has a sufficient supply of fuel on hand and, in the case of pulverized fuel, that his "light-off" equipment is in good condition and ready for use at all times.

Boiler Taken Off Line.

8. When a boiler is being taken off the line and the non-return valve has closed, the main steam valve should be closed. The pressure should be allowed to drop naturally except that the superheater drains should be opened enough to keep condensate from gathering in the headers. Any tendency toward rapid cooling of the furnace by allowing cool air to pass through the setting will cause trouble with brickwork. After the furnace brickwork has lost its color, a moderate amount of air may be admitted.

Vent Valve.

9. When the steam pressure has dropped to five or ten pounds, the vent valve on the steam drum should be opened to prevent a vacuum from being formed in the boiler.

Empty Boiler.

10. The boiler should not be emptied until the furnace has cooled to a temperature at which one can enter and remain in the furnace.

Inspection.

11. While the boiler is out of service, all internal and external parts should be carefully inspected, and leaks of steam or water should be taken up. If necessary, the tubes should be drilled to rid them of scale and sludge. Soot blowers should be inspected to see that no jet is impinging directly on a tube, as this may cause the tube to be badly cut, making necessary a difficult repair or possibly a renewal of a tube.

Caution While Inspecting.

12. When making an internal inspection of any unit, or when cleaning the interior of the heating surfaces, great care must be taken to guard against the possibility of steam or hot water entering the boiler through drains or blow-down valves connected with similar parts of other units under pressure, or the careless opening of a steam or feed valve. Bad cases of scalding have resulted from neglect of this precaution, and the man making inspection or cleaning must satisfy himself that all valves to the unit are closed and must place warning signs.

Open Lights Dangerous.

13. Open lights are not to be used in the steam spaces or fire-boxes of a boiler when it is off for inspection, repair or washing. The lighting of matches or smoking is dangerous, as accumulations of coal dust in stokers or pulverizers may be released and become ignited.

Electric Cap Lamps.

14. For inspection, repair and washing, only very low-voltage lamps should be used. The electric cap

lamp is considered safe for this work. Extension cords from the plant's lighting system will not be tolerated for use in the steam spaces of a boiler as, due to the wet or damp condition, a person is quite susceptible to shock or electrocution.

Inspection of All Equipment, Report of.

15. The General Master Mechanic will make a thorough inspection of turbines, boilers, pumps, etc., in fact, all equipment in and around the power plant, once each week, and make a written report to the Vice President, Operation once each month.

INSTRUCTIONS FOR OPERATION OF DIRECT-FIRED PULVERIZED-FUEL SYSTEMS

In order that reliable results may be realized from the use of pulverized fuel, it is urged that careful attention be given to every detail set forth in these instructions.

REGULAR STARTING

Make Careful Preliminary Inspection.

1. After an inspection shows that everything in connection with the direct-fired unit is in operating order, and if it is desired to fire pulverized fuel, proceed as follows:

A. See that the following dampers and valves are closed:

1. Induced-draft damper.
2. Forced-draft dampers at burner windboxes and secondary-air ports.
3. Fuel-air valves in burner lines.
4. Air-tempering and air-control valves for pulverizer air supply.

B. Start the induced-draft fan.

C. Start the forced-draft fan.

D. Open the induced draft damper to provide an air flow of 20 per cent of the maximum which will correspond to a furnace draft of 0.50", and hold this setting for five minutes before inserting the torch in the furnace.

E. Light the oil torch and see that it maintains the proper flame for lighting off.

F. Open valve in burner line to be used and start pulverizer fan and pulverizer.

G. Be sure that the oil torch is still burning after the fan is operating.

H. Start the raw-fuel feeder. Allow mill differential to raise to .75". Longer operation without passing air through the pulverizer is likely to result in a choked pulverizer.

Air Control Valve.

I. Slowly open the air-control valve supplying air to the pulverizer to the predetermined point. This should insure quick and good ignition within five seconds. Furnace conditions should always be observed from a distance through an observation door.

Failure to Ignite.

J. If the pulverized fuel fails to ignite immediately, shut off the raw-fuel feeder, pulverizer, pulverizer fan and the oil torch, and close the air control valve. Allow five minutes for the furnace to clear itself of pulverized fuel. Failure to ignite may be due to a poor flame from the oil torch or too lean a pulverized-fuel mixture caused either by insufficient feed from the feeder or too much air from the fan to the pulverizer.

After the system has been completely purged of the pulverized fuel, light and adjust the oil torch, and start the equipment again according to items F, G, H, and I above with the exception that the fuel-and-air condition should be readjusted to provide a better pulverized-fuel mixture.

K. Open the forced-draft dampers at the burner windbox and the secondary-air ports and adjust the induced-draft and forced-draft fans to suit operating conditions. The furnace draft should generally be adjusted to 0.25". Operation of the oil torch should never be discontinued before the ignition of the pulverized fuel has become self-supporting and stable. This shall mean that the oil torch must remain lighted in the furnace at least 15 minutes from the time of lighting off and as much longer as is necessary to insure a clean, bright coal flame. In lighting off on a cold boiler, the oil torch must remain lighted during each of the short periods while burner is lighted but inspection of oil supply must be made on off periods to determine that there is sufficient oil for the next light off.

Oil Torch Remain Lighted 15 Minutes.

Regular Operator Lights Off.

When a pulverized-fuel furnace which has been out of service is to be relighted, it shall be the duty of the regular operator to see that all equipment is in operating condition and that the individual units are started in the regular sequence and shall do the actual lighting off. Another of the boiler operators must be stationed at the instrument panel where he can observe the instruments and particularly the flame from the burner. He must remain at position from which he can observe the burner flame until the burner is operating satisfactorily. Should the flame die out, he

Flame Die Out.

shall immediately stop the pulverizer and shut off the primary air and also shut off steam from the air heater. Then proceed as in Section 6, Paragraph B. (Reduce the air flow through the furnace to 10 per cent of the maximum if it is not already at that rate or less. However, do not increase the air flow. Allow five minutes for the furnace to clear itself of pulverized fuel, then close the forced draft dampers.)

The Chief Operator or the General Master Mechanic must observe the lighting off of boilers which have been out of service.

Additional Burners.

L. When there is more than one pulverized-fuel burner connected to the furnace and it is desired to place any additional burners in service, the oil torch should be applied to each burner to be lighted. If the burner to be lighted will be supplied by a pulverizer not already in operation, it is advisable to pass cold primary air through the burner for about five minutes before placing the pulverizer in service according to the regular starting procedure in order to cool off the burner and prevent coking.

Adjustments.

M. Careful observation of flame conditions should be made whenever adjustments are made and the induced draft and forced draft should be adjusted to provide good flame conditions in the furnace.

Temperature of Fuel-and-Air Mixture.

N. The maximum temperature of the pulverized-fuel-and-air mixture leaving the pulverizer should not exceed 130 degrees Fahr. normally and 135 degrees Fahr. should be the maximum or the point where the high-temperature alarm operates. This temperature will vary on account of variation in raw-fuel moisture or the quantity of fuel being pulverized if the quantity and temperature of the air supplied to the pulverizer remain constant. In order to keep the outlet temperature within the desired limits, regulation should be accomplished by adjusting the steam valve on air heater to regulate the temperature of the air entering the pulverizer and not by reducing the quantity of air.

SOOT BLOWING

Soot Blowing.

2. Soot blowing should be done at regular intervals according to schedule suitable for each installation and especially after an initial starting-up period. Soot blowers, however, should be operated only when the boiler is in normal service with a sufficiently high rate of com-

Operate Only When Oxygen Content is Low

bustion to insure a low oxygen content in the flue gases or when the furnace and setting are free from fire and are cold. Before operating the soot blowers, the induced-draft or stack capacity should be sufficient to permit the disturbed conditions, caused by the operation of the soot blowers, being taken care of without resulting in flare-backs or loss of ignition. The customary procedure is to gradually increase the furnace draft well above the required normal operating condition without effecting an increase in the excess air for the burner conditions. If the maximum induced-draft or stack capacity will not provide sufficient furnace draft to permit normal soot blowing conditions, the necessary furnace draft should be obtained by reducing the fuel and air capacity and being certain that suitable burner conditions are maintained during the soot blowing period. Automatically controlled dampers generally maintain the normal furnace draft during soot blowing periods as well as during normal operation. However, the excess induced-draft or stack capacity necessary for proper soot blowing conditions should be checked and the rating reduced if found necessary before starting soot blowing operations. Soot blowers should be operated one at a time for best results.

Caution With Low-Volatile Fuels.

3. When burning low-volatile fuels a large amount of carbon may be in the residue accumulating in the boiler setting. If this accumulation should be on fire either actively or only smouldering, operation of the soot blowers while the boiler is on bank may result in an explosion on account of the smouldering accumulation's being agitated in a supply of air. Soot blowing on these installations should be done at such times that there is a low oxygen content in the flue gases and while the burner conditions are such that the soot blowing will not result in loss of ignition. If soot blowing must be done while the boiler is out of service it should not be attempted before the boiler has been out of service at least eight hours and before being sure that there is no source of ignition in either the furnace or setting which might ignite any of the dust blown into suspension and possibly result in an explosion. If the dust in the setting contains a high combustible content it may be advisable to operate the soot blowers from rear to front and then from front to rear in order to minimize the effect of the combustible blown into suspension.

Slag Removal.

4. When burning fuels having a low ash fusion point, considerable slag is generally deposited in the boiler. In these cases the best results for removing this slag with the least expenditure of energy can be obtained when the boiler load has been brought down to a light operating load. Under this condition the decrease in the furnace temperature will allow the slag to chill and be more readily removed by the soot blower. On installations having more than one pulverizer per boiler, the reduction in the operating load for this purpose can readily be accomplished by changing from two-mill to one-mill operation. On installations having only one pulverizer per boiler but more than one burner, the reduction in the operating load for this purpose can readily be accomplished by changing to one-burner operation. The load carried with either one-mill or one-burner operation should be at a rate to provide normal burner conditions so that the soot blowing will not result in loss of ignition.

LOSS OF IGNITION

Prevent Loss of Ignition by Proper Fuel-Air Mixture.

5. When a pulverized-fuel furnace is operated at low rating or on active "bank," there is usually a higher than normal percentage of unburned-fuel loss and a possibility of losing ignition on account of the cooler furnace. Loss of ignition usually results from variations in the fuel-air ratio and precautions should therefore be taken to obtain and maintain the proper mixture of the fuel and air. The following precautions should be taken to prevent loss of ignition.

A. Operation must be at a sufficiently high rate to maintain ignition with a safe margin.

B. The fuel feed should be continuous and steady during the firing periods.

C. The supply of air should be proportional to the fuel supply, and any change in the fuel or air supply should be made gradually and intelligently.

D. Soot blowers should not be operated during low-rate operation due to causing sudden and uncontrolled changes in the air flow.

If Ignition Lost.

6. If ignition is lost either on account of soot blowing or from any other cause, the operator should proceed as follows:

A. Stop the pulverizer fan, which in turn will trip out the pulverizer and the raw-fuel feeder. This may be done automatically by the use of automatic flame detectors or manually by the operator who should have readily available means for observing the flame. Also shut off steam from air-fin heaters and close air control valve.

B. Reduce the air flow through the furnace to 10 per cent of the maximum if it is not already at that

rate or less. However, do not increase the air flow. Allow five minutes for the furnace to clear itself of pulverized fuel, then close the forced-draft dampers at the burner windbox and the secondary-air ports.

C. Regulate the induced-draft damper so that the air flow will be 20 per cent of the maximum and start the equipment with one pulverizer and one burner in accordance with the routine covered under "REGULAR STARTING" Section 1, items E, F, G, H, and I. In this case, however, the pulverizer already has some partly pulverized fuel from the previous run and the air control valve should be opened slowly immediately after the raw-fuel feeder is started so that the pulverizer will not become choked.

Avoid Quick Changes.

7. Pulverized-fuel furnaces should be operated by making changes gradually and by avoiding extremes. Even though a wrong condition exists, such as loss of ignition, a quick change in either reigniting the fuel or in changing the rate of air flow should be generally avoided and all changes should be made with full knowledge of the existing conditions.

REGULAR SHUT-DOWN

Regular Shut-Down.

8. When it is desired to shut down a direct-fired pulverized-fuel unit and the unit is coming off the line in the normal way, proceed as follows:

A. Shut off steam to air-fin heater. Continue operation for about five minutes or until the pulverized-fuel-and-air mixture leaving the pulverizer is approximately 100 degrees Fahr.

B. Stop the raw-fuel feeder.

C. Stop the pulverizer when empty. When the flame (at the burners in connection with the pulverizer being shut down) goes out, the pulverizer may be considered empty for shutting-down purposes. The operator will usually notice a more metallic sound being emitted from the pulverizer.

D. Close the fuel-air valves in the burner lines.

E. Stop the forced-draft fan and close the forced-draft dampers at the burner windbox and the secondary-air ports.

F. Stop the induced-draft fan and close the induced-draft damper after a five-minute period.

EMERGENCY SHUT-DOWN

Emergency Shut-Down.

9. When an emergency shut-down is necessary and there is sufficient time to permit clearing the pulverizer, proceed as follows:

A. Shut off steam to air-fin heater.

B. Stop the raw-fuel feeder.

C. Stop the pulverizer when a decided metallic sound is noted.

D. Stop the pulverizer-fan.

E. Close the air-control valve and the valves in the fuel-air lines in the burner lines.

F. Stop the forced-draft fan and close the forced-draft dampers at the burner windbox and the secondary-air ports.

G. Stop the induced-draft fan and close the induced-draft damper, after a five-minute period.

FORCED SHUT-DOWN

Forced Shut-down.

10. In case a shut-down of the pulverizing equipment occurs and the pulverizer has not been run empty (caused by an electrical trip-out of some of the equipment in the electrical interlock), the equipment should again be put into service within thirty minutes after the shut-down according to the method described under "REGULAR STARTING" except that the air control valve supplying air to the pulverizer should be opened slowly immediately after the raw-fuel feeder has been started since the pulverizer already has a supply of partly pulverized fuel and a delay in passing air through the pulverizer may result in a choked pulverizer. Operate the equipment with the pulverized-fuel being fired for about 15 minutes. If it is then desired to discontinue operation, the equipment should be shut down in the normal way by running the pulverizer empty as described under "REGULAR SHUT-DOWN."

Inspect Pulverizer For Fire.

If the equipment cannot be started within thirty minutes after the shut-down and if the pulverizer is hot, open the access door and air port clean-out doors carefully and inspect the pulverizer for fire. If no fire is found, start the equipment as noted above. In case a fire is found in the pulverizer, quickly close the access door and the air port clean-out doors and proceed as noted under "FIRES IN PULVERIZERS" Section 11.

FIRES IN PULVERIZERS

Fires in Pulverizers.

11. A pulverizer stopped in an emergency is likely to have considerable partly pulverized fuel in it and if the pulverizer is hot and allowed to stand in this condition for some time, the fuel may ignite. To reduce this possibility we have recommended under **"FORCED SHUT-DOWN"** that the equipment should again be put into service as soon as possible after a shut-down of the pulverizing equipment occurred if the pulverizer had not been run empty. If it is impossible to run the pulverizer empty, proceed as follows:

When Impossible to Run Pulverizer Empty.

A. If the shut-down occurred while the air-and-fuel mixture leaving the pulverizer was at or over 135 degrees Fahr., and there is no fire in the pulverizer, clean out the pulverizer by hand as soon after the shut-down as possible.

B. If the shut-down occurred while the air-and-fuel mixture leaving the pulverizer was less than 130 degrees Fahr., the partly pulverized fuel may be left in the pulverizer provided operation will be resumed within three (3) hours.

C. If the shut-down will exceed three (3) hours, it is advisable to clean out the pulverizer by hand as soon as possible and take advantage of this opportunity to inspect the pulverizing equipment.

If a fire does occur in a shut-down pulverizer, the operator should proceed as follows:

A. See that steam is shut off air-fin heater. The other valves in connection with the pulverizer are normally closed as routine operation during a shut-down, however, check that these other valves (namely, the air-control valve and the fuel-air valves in the burner lines) are closed.

B. Open the air port clean-out doors, one at a time and drench the interior at the air ports with the discharge from a chemical fire extinguisher or steam. Close the clean-out doors. The operator should stay out of direct line of the clean-out openings.

C. Repeat the drenching at the air port clean-out doors for one-half hour at intervals of about ten minutes.

D. Open the access door carefully, taking precautions that any gas which may have been generated during the period of the fire will not ignite, and drench the interior with the discharge of a fire extinguisher or steam. When the fire has been extinguished and the fuel has been cooled below the ignition temperature and after any poisonous gases which may have been in the pulverizer have escaped, the pulverizer should be cleaned out so that it is certain that there is no trace of fire or smouldering remains. Air in any way should never be used for cleaning pulverized-fuel equipment suspected of containing fire, and we consider the use of vacuum cleaning systems for cleaning pulverizers as hazardous at any time.

E. Inspect and clean out the pulverizer windbox, air inlet ducts, outlet pipes, pulverizer fan, and feeder of any residual fire.

F. When certain that the pulverizer and related equipment is clear of all traces of fire, the equipment may again be put into operation according to the normal procedure.

Fires in Pulverizers in Operation.

12. Fires in pulverizers during operation are of very infrequent occurrence. They may, however, originate from a variety of causes, such as:

A. Too high temperature of air to the pulverizer.

B. Fire in raw-fuel bunker.

C. Fire started in idle equipment by welding or burning operations. Equipment should always be inspected after these operations. Welding or burning operations inside any piece of pulverized-fuel equipment should not be started without first taking some precautionary measures to prevent sparks or molten metal from starting a possible fire.

D. There is some evidence that coal high in pyrites is more susceptible to ignition than other coal.

In addition to the fact that fires in operating pulverizers are infrequent and those that do occur are usually put out without damage or even interrupting operation, the occurrence of fire must be looked upon as serious and should be dealt with promptly and adequately.

The object of all methods of dealing with this class of fires is to smother them by reducing the oxygen (air) to a point where combustion will not be supported.

A fire in an operating pulverizer usually makes its presence known by an increase in the outlet fuel-air temperature that cannot be accounted for by changes either in the raw-fuel moisture or the air-inlet temperature. Moreover, this increase in outlet temperature is sudden and of considerable magnitude, usually of the order of 100 degrees Fahr. or more—the maximum normal outlet temperature should not exceed 135 degrees Fahr.

Suspected Fire in Operating Pulverizer.

If a fire is suspected in an operating pulverizer, the operator should proceed as follows:

A. Increase the raw-fuel feed to the pulverizer to the maximum pulverizer capacity. If the pulverizer is already operating at maximum capacity, be sure that the raw-fuel feed is not decreased.

B. Change over from hot- to cold-air operation. Avoid increasing or making sudden changes in the air flow through the pulverizer and boiler.

C. If the temperature rise of the outlet air is checked and starts to return towards normal in a few minutes, continue operation until the normal outlet temperature is restored. The pulverizer capacity may then be reduced according to operating demands. However, if the pulverizer capacity is reduced, be sure that the air flow through the pulverizer is also reduced so as to keep a rich fuel-air mixture in the pulverizer.

D. Special precautions should be taken to see that the raw-fuel feed is not interrupted during the entire time that a fire is suspected. If the raw-fuel feed should be interrupted, immediately shut down the pulverizer-fan which will also trip out the pulverizer and feeder and close all valves connected to the pulverizer.

E. If the temperature rise of the outlet air is not checked and does not start to return towards normal in fifteen minutes after having changed from preheated to cold air, proceed as follows:

1. Close the air-control valve.
2. Shut down the pulverizer-fan, which will also trip out the pulverizer and feeder through the electrical interlock. Close the fuel-air valves in the burner lines.
3. Proceed to take care of the fire as described in Section 11 covering fires in pulverizers which are shut down.

FIRES IN OTHER EQUIPMENT OF PULVERIZED-FUEL SYSTEMS

Fires in Other Equipment.

13. A fire found in any other part of the pulverized-fuel system, as between the pulverizer and the burners, should be smothered, and drenched with the discharge from a chemical fire extinguisher or steam. However, any accumulation of fine dust should not be disturbed and drafts over the area on fire should be avoided. After the fire has been smothered, the equipment should be cleaned and all the equipment in connection with the unit should be carefully inspected before the unit is again put into service.

Fires In Fuel Bins.

A fire in the raw-fuel bin should be looked upon as serious and should be dealt with promptly and adequately the same as a fire discovered in an operating pulverizer. The fire should be smothered if possible and in bins provided with covers steam may be piped into the bin. In open-top bins steam may be piped into the affected area. After the fire has been smothered, the bin should be run empty and in feeding this raw fuel to the pulverizer special care should be taken that the pulverizer is being fed continuously at maximum capacity with the least possible air flow. Continuity of feed at this time is especially important in order to safeguard against a possible hazardous condition. If for any reason the feed to the pulverizer should stop, the pulverizing equipment should be shut down immediately by tripping out the pulverizer-fan, which trips out the pulverizer and feeder through the electrical interlock, and all valves in connection with the pulverizer should be closed to prevent a draft through the pulverizer. If inspection of the pulverizing unit then proves that no fire is present and the cause for the feed interruption has been removed, the unit should again be put into service to continue the emptying of the raw-fuel bin. This subsequent operating period should be observed just as carefully as the period before the interruption took place and should continue until the raw-fuel bin is empty.

We are indebted to the Babcock & Wilcox Company, Service Department, for assisting in the drafting of these instructions.

ELECTRICAL STANDARDS

The mine foreman, who is held responsible under the law for the safety and general condition of the mine, is recognized as the man in authority in and about the mine.

General Instructions.

The mine electricians are expected to follow the orders of the mine foreman in the performance of routine work, repairs, and the installation of such extensions as may be required in the regular operation of the mine. They will also receive orders from the local chief electrician as to the general methods and special work when necessary.

The extensive use of electricity in our mines raises many problems which require special training that a mine foreman should not be called upon to acquire. The mine electrician should be impressed with the necessity of observing improper conditions and reporting them to the proper authorities, with suggestions covering their remedy.

The following rules and regulations are to be considered as standard for the use of electricity, both underground and on the surface, at the mines of The Union Pacific Coal Company. They will be enforced, and are hereby understood to be in force and effect as of this date.

GENERAL INSTRUCTIONS

Electrical Map.

1. At each mine there shall be posted a plan map showing the mine wiring, cables, conductors and the location of permanently installed electrical machinery, the legend shown thereon to be as follows:

Yellow—High Voltage (2300 V.).

Red—Low Voltage A. C.

Brown—Low Voltage D. C.

Mining machines, pumps, hoists, locomotives, fans, etc., shall be designated by note.

These plans will be revised by the local Chief Electrician at intervals not exceeding six months, and oftener when necessary.

Inspection.

2. A rigid, systematic and careful inspection of all electrical equipment, cables and supply lines shall be made monthly, a report of this inspection to be forwarded to the office of the General Manager in Rock Springs.

NOTE: This inspection shall cover the points outlined under heading—"Instructions to Persons Inspecting Electrical Equipment."

Voltage.

3. In all future installations within the mines, the voltage shall not exceed 2300. This potential, which may be brought in and applied to motor-generator sets, hoists, pumps or other apparatus upon the recommendation of the Vice President, Operation, shall be installed under the direction of the Chief Electrician. Mining machines, locomotives or small capacity motors (less than 25 H. P.) shall not have a voltage in excess of 275.

Proper Mounting.

Special attention shall be paid to the proper mounting of all equipment, enclosing wherever possible in steel or transite-board boxes all devices such as switches, current transformers, potential transformers and rheostats.

Installation Approval. Painting.

Permanent installations, before being approved and placed in operation, must be thoroughly inspected by the Chief Electrician or local Chief Electrician and shall be properly painted. Light-colored paint shall be used on all underground installations.

GROUNDING

Grounding.

1. The frames, casings or inclosures of all stationary electrical apparatus, such as motors, motor-generator sets, rotary converters, transformers, starting and control apparatus, oil switches, cable sheaths, conveyors, hoists, or other equipment that may become accidentally charged with electric current, shall be grounded.

(By grounding is meant making a permanent connection to the general mass of earth in such a manner as will insure at all times an immediate discharge of electric energy to the earth without danger.)

A thorough inspection of all ground connections will be made every thirty days.

Size.

2. Ground wires shall not be smaller than No. 4 B & S gauge and need not be larger than 00 B & S gauge.

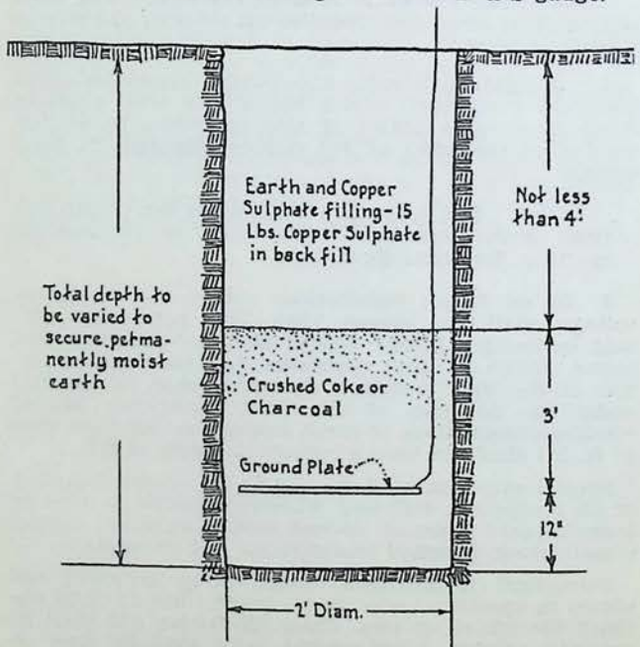


Fig. 1—How Grounds Are Made.

Method used to obtain low-resistant ground connections for lightning arresters and electric machinery. Unless special means are used, good grounds cannot be obtained in dry localities. Electric protective equipment is valueless without an efficient ground contact. Connections should be made to pipe lines wherever possible.

Ground Terminals.

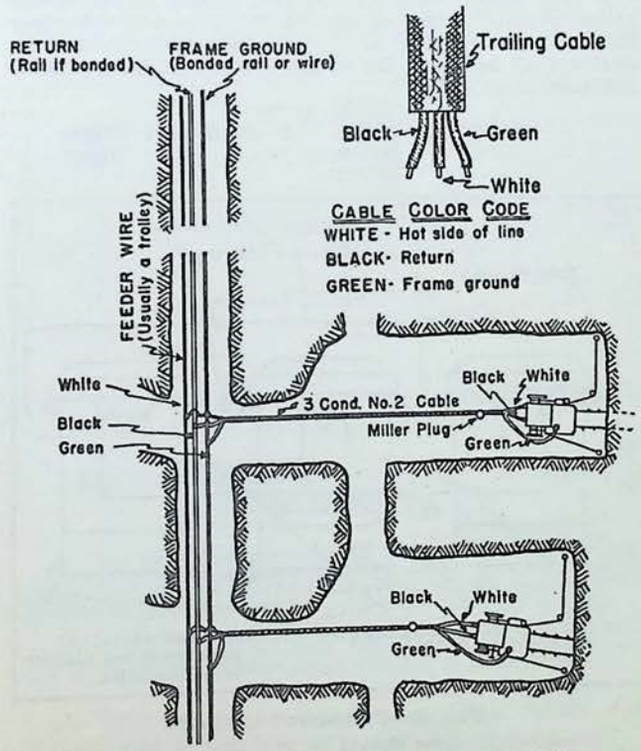
3. Ground wire connections to the apparatus shall be made by means of an approved clamp or terminals soldered to the ground wire and securely bolted to the apparatus where its removal will be unnecessary for inspection and repairs.

Connections to Ground.

4. All ground connections shall be made to pipe lines, track, or to buried ground plates or pipes which shall be in contact with permanently moist earth, these connections to be mechanically secured and soldered, welded or clamped. (Fig.1.)

Approval.

5. All ground connections shall be approved by the local Chief Electrician and, in case any doubt exists as to the reliability of ground connections as designated



GROUNDING MOBILE TYPE EQUIPMENT.

Fig. 2.

in the foregoing paragraph, he shall withhold approval until sufficient ground connections have been made to serve the purpose for which intended.

Ground Wire in Pipe.

6. Ground wires should be straight and as short as possible and, where necessary to run in conduit, the ground wire shall be electrically bonded thereto.

Stranded Ground Wire.

7. Solid wire may be used as a ground conductor, excepting that stranded conductor shall be used to ground apparatus subject to movement or excessive vibration.

Continuity.

8. Ground wires shall be installed in such a way that they may be inspected for continuity and will be protected from mechanical injury.

Mining Machine Grounds.

9. For method of grounding D.C. mining machines and other types of mobile equipment, see Figure 2. Wherever three conductor cables are in use, the frame ground conductor shall be green, the return conductor black, and the hot conductor white.

Cable code:

3—conductor:	White Green Black	2—conductor:	White Black

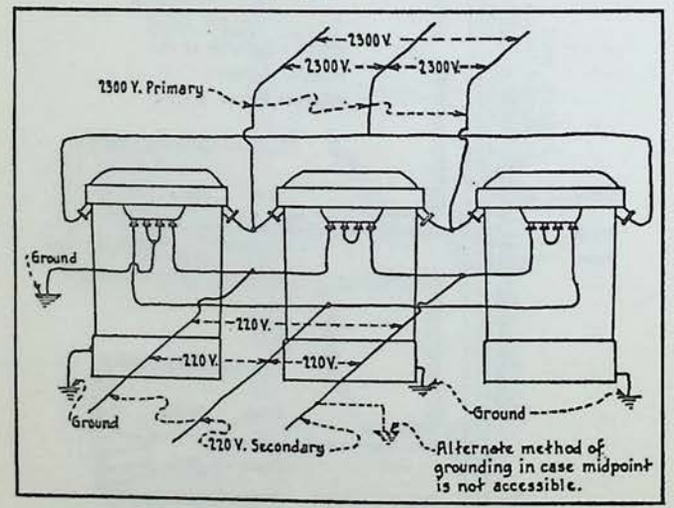


Fig. 3—Permanent Grounds.

Transformer cases should be grounded in such a manner that the earth contact is not disturbed during ordinary inspection and repair work. If the midpoint of a transformer secondary winding is not accessible, one secondary line should be grounded.

10. Transformer cases, oil switches and supporting frames shall be effectively grounded.

Transformer Grounding.

11. The secondary of one transformer of each 3 phase bank shall be grounded at the point which brings about the lowest voltage from ground to live conductor. (Fig. 3.)

12. Single phase lighting transformers shall have the case and one side of the secondary grounded. (Fig. 4.)

Duplicate Grounds.

13. All 2300-volt motors driving motor-generator sets, hoists, or fans or general-purpose motors shall be provided with duplicate ground connections. Ground connections leading in different routes are preferred. Iron conduit, although grounded, connecting the motors will not be considered as constituting a ground conductor.

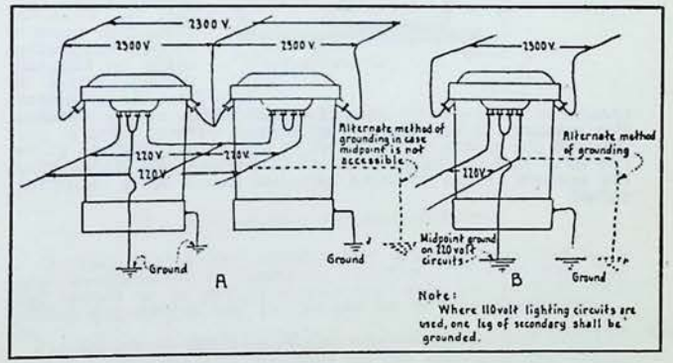


Fig. 4—Protecting An Open-Delta and Single-Phase Connection.

A—The secondary circuit may be grounded either at the midpoint of a transformer winding or by making an earth connection to one of the line wires. In all instances the casings of the transformers should always be grounded.

B—This arrangement is usual for lighting transformers, but in all instances the tank should be grounded and also the midpoint of the secondary winding or a line wire.

Rotary Converter Grounds.

14. Transformer secondaries supplying rotary converters shall not be grounded. (See Fig. 5.)

Arrester Grounds.

15. Lightning arresters shall have adequate ground connections.

Instrument Grounds.

16. The cases of all instruments, relays and meters shall be grounded with No. 12 B & S gauge copper wire. Secondary circuits of potential and current transformers shall be grounded with a conductor not smaller than the conductor of the secondary circuit.

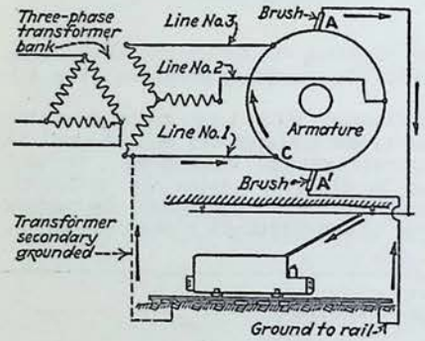


Fig. 5
No Grounds Used on Transformers for Rotaries.

There is a physical circuit connection between the alternating-current energy and the direct-current supply in a rotary converter, consequently, since the direct-current system is normally grounded, another earth connection made to the secondary wires of the transformers creates a short circuit around a part of the rotary winding. For instance, if line No. 1 is grounded, current from A goes through the motor and returns to the rotary via two paths, one to A' and the other to point C through line No. 1. Thus the section of the winding between C and A' is short circuited.

BONDING

Replacing Broken Bonds.

1. IT IS MANDATORY THAT ALL BONDS FOUND OR KNOWN TO BE DEFECTIVE OR BROKEN BE REPLACED ON THAT SHIFT OR BEFORE THE BEGINNING OF THE SUCCEEDING SHIFT. (See Rule 8.)

Placement.

2. All tracks used as a conductor for electric current shall be bonded at every joint and cross bonded at intervals not exceeding 300 feet.

Switch Bonding.

3. Bonds at switches, frogs and turnouts shall be applied as shown in Fig. 6.

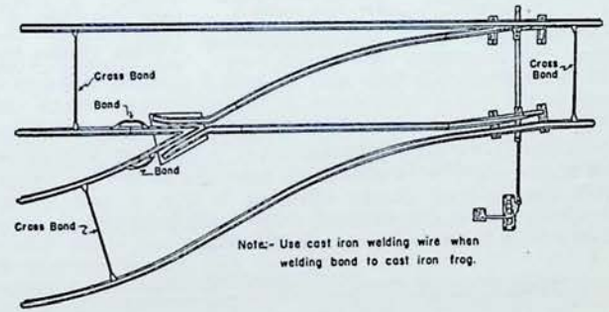


Fig. 6—Bonding Around Switches.

A well-bonded rail system may easily be spoiled by a poor arrangement of bonds at switches and turnouts. The aim should be to obtain a two-rail path for current both around the switch and to the tracks leading therefrom.

Kind.

4. All bonds shall be of the arc-weld type and shall be welded to the base of the rail on the inside of the track, and of sufficient length to span splice bars or fish plates unless otherwise approved.

NOTE: Bonds shall be 4" longer than splice bars or fish plates.

Welding.

5. Bonds shall be welded in such a way as to give proper conductivity and permit of complete salvage. (See Fig. 7.)

Inspection.

6. All track bonding shall be given a thorough physical inspection every three months, and a report of the findings forwarded to the General Manager at Rock Springs.

Open Flame Torches.

7. Bonding and the use of an open flame blow torch on electrical work may only be done on the offshift periods, and then the proper safeguards must be taken to avert accident from this cause.

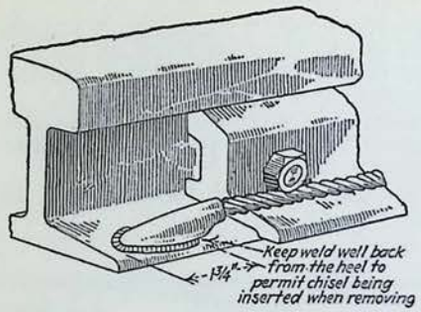


Fig. 7

The primary thought in applying a bond should be to obtain high conductivity at the joint. However, it should be done in such a manner that the bond may be completely salvaged, so that they will be better protected and yet be easily removed when it is necessary to do so. Bonds should be welded to the inside section of the base of the rail.

Repairing Broken Bonds.

8. When it is necessary to make temporary repairs to one or more broken track bonds, a suitable section of 4-0 bare copper wire should be fastened to broken bonds with two ½-inch Crosby clips, as in Fig. 8, permanent repairs to be made without delay. All bonds should be thoroughly inspected every thirty days.

Inspecting Bonds.

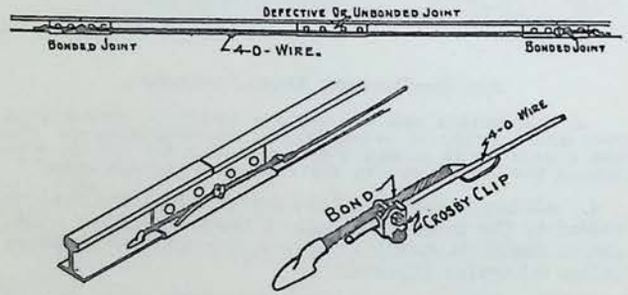


Fig. 8—Temporary Bonds.

TROLLEY WIRES

Type and Sizes.

1. Trolley wires shall be No. 4-0, B and S Gauge grooved, and shall be supported on hangers of Type O. B. Cat. No. 11,309 and clamps O. B. Cat. No. 14,489, or equivalent.

Height.

2. The height of trolley wire above the rail shall be made as uniform as practicable.

Alignment.

3. Trolley wires shall be placed so as to give the maximum practical clearance and shall be kept in as straight a line as possible. They shall have a maximum height of not to exceed 6½ feet and a minimum of not less than 4 feet.

Hanger Spacing on Straight Runs and Curves.

4. On straight runs the hangers shall be placed not more than 20 feet apart where the height of the roof above the track is 5 feet or less, and not more than 25 feet apart where the roof is more than 5 feet above the track. On curves the hangers shall be so placed that the trolley wire at any one hanger may be entirely disconnected without exposing the locomotive runner to danger of contact.

Sectionalizing.

5. Underground trolley circuits over 2,000 feet in length shall be sectionalized at least every 1,500 feet by placing in the line a switch, right or left hand as required, by which the line can be entirely disconnected from the source of supply. All branch trolley lines shall be provided with a frog at the point where they leave the main, and also with an automatic switch installed at or near the frog by which the branch will automatically be disconnected from the main. (Fig. 9.)

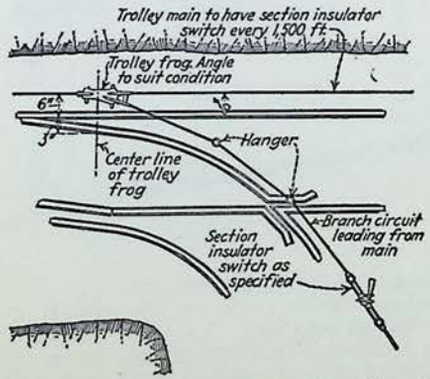


Fig. 9

Underground trolley circuits should be laid out so that a section insulator switch is located every 1,500 ft. in the line. Branch circuits should be equipped with a section insulator switch at the point where a tap is taken from a main trolley wire.

Location Signs.

6. Appropriate signs designating locations of disconnecting switches shall be placed along the line.

Automatic Switches.

7. Automatic cutout switches similar to that shown in O. B. Cat. No. 9,034, shall be installed at partings to cut current off wires when not required. In this case a special light circuit shall be run to serve the parting.

Trolley Deadends.

8. All trolley lines shall be dead-ended by an insulated turnbuckle and dead-end cam grip similar to O. B. Company, Cat. No. 14,630 and 14,794, same to be suspended from hook or eyebolt of appropriate design. (Fig. 10.)

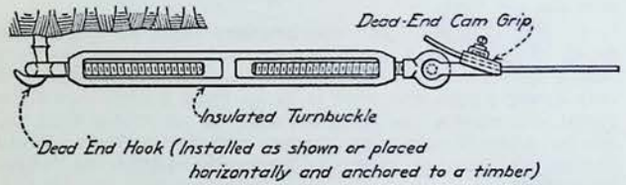


Fig. 10—Standard Dead-End For Trolley Wire.

LIGHTING AND LIGHT WIRES

Location.

1. Electric lamps shall be installed at all partings, switches, passageways that cross haulageways, workrooms, pumps, hoist, and motor-generator rooms, and other points as the mine foreman may direct.

Portable Lamps.

2. Portable lamps shall be fitted with rubber-clad cord (similar to Tirex), and the lamp shall be protected with a wire guard of the Protex type.

Trolley Attachment.

3. Lighting wires shall be attached to trolley or power lines by O. B. current tap, which will permit the circuit's being disconnected while the base of a broken lamp is removed.

Method of Installing.

4. All wiring shall be supported on porcelain insulators, and when the track is used as a return for the lighting circuits the return wire shall be attached to the track by bonding to the rail or by attachment to regular bonding. (Fig. 11.)

Wire Size for Light Grounds.

5. The ground connection shall be made of not less than No. 8 B & S Gauge copper wire which shall be buried below the surface of the floor and carried to the side of the entry and thence on porcelain insulators to the roof.

Voltage.

6. All electric lamps connected to trolley lines for lighting underground shall be 275 volts.

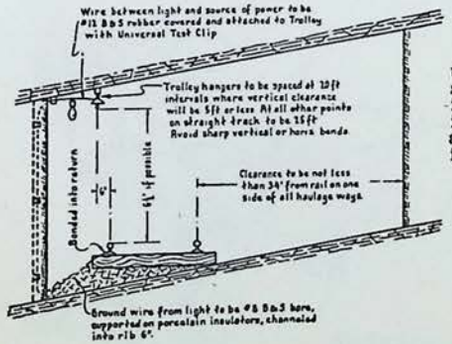


Fig. 11
The haulage system of a mine is so important that it is necessary to install all feeder and trolley circuits in a safe manner.

Socket Type Connections.

7. All sockets will be weatherproof type (similar to G. E. Cat. No. 60,666). Light wiring shall be not less than No. 12 B and S Gauge, rubber covered, and shall be supported on porcelain insulators or split knobs and held free from timbers, coal and rock.

Insulator Type and Fastening.

8. Wires may be fastened to glass insulators, screw or wood pins driven into the roof or on No. 3½ W. G. porcelain insulators fastened to timbers with ⅜"x3½" lag screws with a ⅜" cut washer under head. Wires must not be nailed to posts either with or without insulators.

Bulb Replacement.

9. Lamp bulbs shall be replaced only by the Mine Electrician or a person authorized by him.

Two Wire Circuit Insulation.

10. With all two-wire circuit installations, wherein one wire constitutes a permanently grounded return, the ground wire shall be installed in the same manner and afforded the same support and insulation as the live or supply wire.

Provision for Disconnection.

11. Any branch two-wire circuit leaving a main circuit shall be provided with a double-pole fused switch of the safety enclosed type to protect the wires leading from it and for cutting off all current within the branch circuit.

CABLES AND POWER LINES

Location.

1. Electric conductors shall not be permitted in any return air course unless permission in writing is first obtained from the General Manager and the Safety Engineer. In case this permission is granted, the cables so installed shall be lead covered and armored.

Crossings at Slope and Manway.

2. All wires or cables crossing hoisting slopes, panels or traveling ways, when subject to mechanical injury, shall be carried under the roadbed or track in iron conduit at such a depth that they will be free from injury.

Conductor 660-V. Classification.

3. For low-voltage conductors the live wire shall have rubber insulation (660-Volt Classification) and shall be provided with two woven weather-proof braids. The grounded wire may be bare.

Panel Power Supply.

4. In panels the cable is to be carried in the passageway parallel to the panel slope.

Circuit Breakers.

5. Each section of the mine operating mechanical loaders shall be equipped with automatic reclosing circuit breakers and a disconnecting switch ahead of each circuit breaker.

Surface Disconnecting Switch.

6. All 2300-volt power circuits leading underground shall be provided at the surface with a disconnecting switch in each conductor capable of opening the circuit under load. (Fig. 12.)

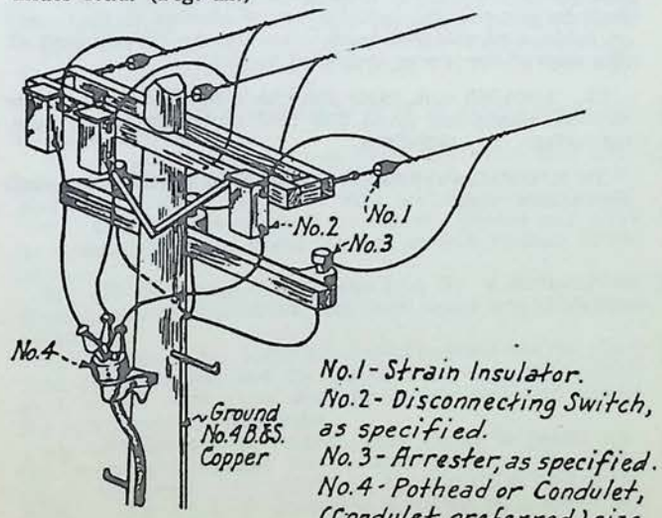


Fig. 12—Protect All Cables

Wherever 2300-volt energy must be taken inside the mines, each wire should be protected by a disconnecting switch and lightning arrester. Provision should also be made to open any or all of the line wires by means of a switch or group of single switches.

Type, Continuity and Grounds.

7. All 2300-volt cables in damp or wet places, in bore-holes or underground, shall be lead covered and armored. The armor shall be electrically continuous throughout and shall be effectively grounded.

Cables Buried.

8. Buried cables shall be leaded and armored or placed in metallic conduit.

Cutouts.

9. Underground cables leading to motors, and particularly those remotely situated from other points of disconnection, shall be provided with oil circuit breakers.

Cables for Permanently Dry Mines.

10. In permanently dry mines the lead sheath may be omitted if the cable is provided with a rubber belt around all conductors and enclosed in a metallic armor to protect it against injury from abrasion.

Support and Grounding.

11. Cables in entries or passageways shall be supported by cable rings on messenger wire. The supporting messenger wire shall be effectively grounded at intervals not exceeding 500 feet.

Cable Splices and Taps.

12. Cable splices and taps shall be insulated with varnished cambric or rubber and friction tape which shall be equivalent to the insulation of the cable itself. The completed joint shall be painted with two coats of No. 1206 Glyptal Lacquer, and two hours allowed for each coat to dry. After the second coat is thoroughly dry, the joint shall be served with metallic armor similar to that used on cable, and soldered band wires should be provided at the ends of the armor to hold it in place.

13. 1,000,000 c.m. cable shall be a minimum for power circuits emanating from 300 KW motor-generator sets, converters, or rectifiers.

14. A metallic return circuit shall be provided for each conversion unit.

SIGNAL AND PHONE LINES

Installation.

1. TELEPHONE LINES SHALL NOT BE INSTALLED ON THE SAME SIDE OF AN ENTRY AS POWER LINES.

Precaution in Installation.

2. EVERY PRECAUTION SHALL BE TAKEN TO PREVENT CONTACT OF TELEPHONE AND SIGNAL WIRES WITH POWER LINES.

Signals Underground.

3. IN SO FAR AS THE FOLLOWING SIGNALS APPLY, THEY SHALL BE USED WITHIN THE MINE ON THE TELEPHONE SYSTEM. A PRINT, 8¼"x10¾", SHOWING THE CALLS, SHALL BE POSTED AT EACH PHONE. THE LETTERING USED SHALL NOT BE LESS THAN ¼" HIGH AND INSTRUCTIONS COVERING THE USE OF SWITCHES SHALL BE SHOWN THEREON.

Tipple	3 short.
Outside hoist	1 short, 1 long, 1 short.
Mine office	3 long.
Mine Foreman	1 short, 1 long.
Machine Boss	1 short, 1 long.
Rope runner	2 long.
Sub-slope hoist	1 long, 1 short.
Sub-slope rope rider or Parting	1 long, 2 shorts.

Outside Installation.

4. TELEPHONE AND SIGNAL LINES BETWEEN THE MINE OPENINGS AND BUILDINGS SHALL BE IN UNDERGROUND CONDUIT WHEREVER THERE IS POSSIBILITY OF THEIR COMING IN CONTACT WITH THE HIGH-VOLTAGE LINES, THROUGH ACCIDENT TO THE HIGH-VOLTAGE LINE OR TO THE SIGNAL OR PHONE LINE.

Type of Telephone.

5. Mine telephones shall be of W. E. Co.'s type 1336J, or its equivalent.

Signal Line Protectors.

6. At points where wires enter the mine they shall be protected by a W. E. Co.'s Type 58 A. P. protector installed in a wood box lined with $\frac{1}{16}$-inch asbestos board.

Phone Wire.

7. Telephone wire shall be rubber covered and shall be supported in the same manner as low-voltage power lines.

Signal Wire Size.

8. All slope signal wires shall be No. 9 Birmingham Wire Gauge or equivalent, and shall carry not more than 30 volts.

Support for Signal Wire.

9. Supports for slope signal wires shall not be more than 20 feet apart and the distance between wires shall be 6 inches. All wires shall be drawn taut and extend the full length of the slope.

Phone Line Protection.

10. Telephone and signal lines liable to make contact with high-voltage power lines shall, at the point where they enter the buildings, be protected with a W. E. Co.'s type 58 A. P. protector installed in a wood box lined with ⅛-inch asbestos board.

OVERHEAD DISTRIBUTING LINES

An overhead distributing line is taken to mean any circuit or aggregation of circuits on poles, including supporting elements, that are used for supplying electrical energy at a potential not exceeding 2300 volts. It includes motor, lighting, signal and telephone circuits, etc.

Pole Spacing. 1. Pole spacing shall be 100 feet in streets and alleys.

Inspection. 2. Pole lines shall be inspected every two years to determine condition of butts below the ground line. This inspection shall consist of digging at least 18 inches below the ground line and adjacent to the pole and the condition of the wood determined by a blow from a digging bar. In addition, it shall be the duty of any employe, whose duty it may be to climb a pole, to assure himself, by visual or other inspection, that the butt is in good condition and that the pole is safe to work upon.

3. All lines shall be inspected every two months to determine their general condition.

Cross-arms. 4. Cross-arms shall have a center pin spacing of 30 inches and a side pin spacing of 14½ inches.

Circuits on Cross-arms. 5. All wires of the same circuit shall be carried on the same cross-arm.

Vertical Risers. 6. Vertical risers on poles from underground cables shall be enclosed in a metal conduit.

Strain Insulators. 7. Guy wires shall have an interlocking strain insulator which shall be located so as to give 6 feet of horizontal clearance from the pole guyed.

8. All poles to which guys are attached shall be protected with guy shims and guy hooks.

Climbing Space. 9. For climbing space on poles see Figs. 13 and 14.

Cross-arm Spacing. 10. Cross-arms carrying power wires of the same voltage shall have a vertical spacing of 24 inches.

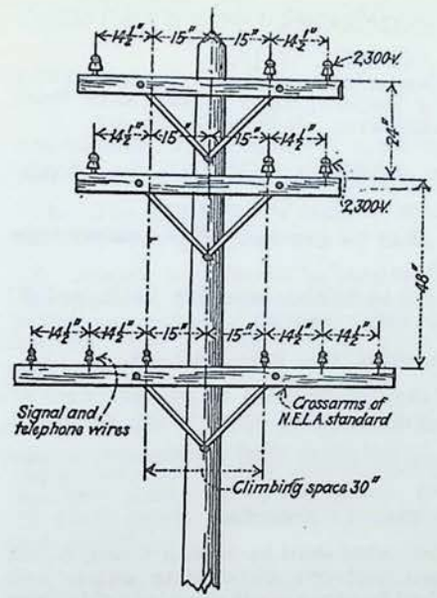
11. Cross-arms carrying signal and telephone wires shall have a vertical spacing not less than 48 inches from power lines.

Conductor Sizes. 12. Material and minimum size of conductors shall be as follows.

2300-volt lines, No. 4 B. and S. Gauge M.H.D. Copper.
110/220-volt lines, No. 6 B. and S. Gauge M.H.D. Copper.

Signal and telephone lines, No. 9 B. W. G., E. B. B. galv. iron wire.

Pole steps shall be ⅝"x9" gal. iron.



Legend:
M. H. D.—Medium Hard Drawn.
B. W. G.—Birmingham Wire Gauge.
E. B. B.—Extra Best Best.

Legends.

Fig. 13

Climbing space provided by setting all wires on the cross-arms so that none comes closer than 15 inches to the center line of the pole. Thus a 30-in. space is always kept.

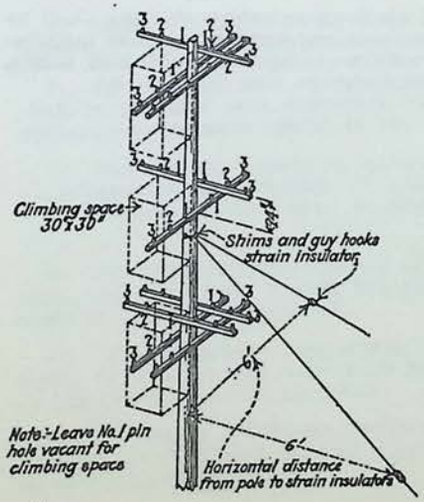


Fig. 14

There is no need for the lineman to wind around the pole to get to the uppermost wires when buckarm construction is properly maintained. Note the 30x30 in. climbing space is maintained on one side of the pole.

WIRING IN UNDERGROUND STATIONS

The following rules include such places as hoist, pump and motor-generator stations, repair rooms, Mine Foreman's cabin, toolrooms, etc.:

Installation. 1. Wiring for lights shall be installed in metal conduit.

Switch Type. 2. Each room shall be provided with a safety type of entrance switch.

Wire. 3. Wire shall not be smaller than No. 12 B. and S. gauge and shall be rubber covered.

Fixed Lights. 4. Ceiling lights shall be in fixed positions.

Receptacles for Portables. 5. Receptacles shall be installed on opposite sides of the room for attaching portable lamps where necessary.

Number Lights. 6. No more than six lights shall be installed on any one circuit.

Grounding. 7. All conduit shall be grounded.

Lights at Explosive Distributing Stations. 8. No wiring for lights shall be carried within 5 feet of any underground explosive distributing station and special attention shall be given to all electric installations in the vicinity of such stations.

Insulated Platforms. 9. An insulated platform or rubber matting shall be provided at all permanent underground electric installations regardless of voltage—pumps, generator sets, hoists, main line switch boxes, etc.

WIRING OF SURFACE BUILDINGS AND TIPPLES

Method. 1. All buildings shall be wired in metal conduit, special attention being given to neatness and the proper support and installation of fittings.

Voltage. 2. The voltage to be used for such work shall not be greater than 250 volts.

Electric Heaters and Guards. 3. Electric heaters will be installed only with the written approval of the General Manager. Electric heaters in weigh rooms shall be stationary and connected to separate circuits from lighting circuits. They shall be protected with suitable guards to prevent inflammable material from coming within 8 inches of the heating elements.

Fire-Resisting Rooms for Motors. 4. Motors in dusty places shall be installed in separate rooms which shall be made fire resisting by lining with metal lath coated with cement plaster or by metal and wire glass construction. Motors, switches and controls in dusty places shall be of dust-tight construction and installation.

Motor Wiring. 5. Motor wiring shall be installed in metal conduit. Special attention shall be given to guarding exposed conductors and parts that may give electric shock.

Grounds. 6. Motor frames, starting compensators and control equipment shall be effectively grounded.

Secondary Trip Coils. 7. Oil switches now equipped with series trip coils shall be provided with secondary trip coils operated by current transformers placed in the high-voltage circuit.

Non-Freezing Oil. 8. Starting compensators, controllers and switches containing oil, the freezing of which will render the apparatus less effective, shall be filled with non-freezing oil.

Switch Type. 9. All knife switches shall be of the safety enclosed type, and shall have a steel box enclosing same which shall be effectively grounded.

Lights In Powder Houses. 10. Surface powder houses may be wired for electric lights (110 volts) but only under the direct supervision of the Chief Electrical Engineer.

Insulated Platform or Mats. 11. Adequate insulated platforms or rubber mats shall be provided and used as a protection in handling all electric switches.

HOISTS

Fireproofing. 1. Permanent hoist rooms are to be fireproofed, in a manner determined by the General Manager, with the approval of the Safety Engineer. (Temporary locations are those wherein the machine will be in service in one position less than 6 months.)

Grounds. 2. Hoist motor, controller, control equipment, oil switches, cable sheaths; current, potential, power and lighting transformers; switchboard frames, resistance boxes, and supporting frames, shall be grounded as heretofore provided.

Installation. 3. There shall be installed at each hoist and mechanical loader installation suitable disconnecting switches to open each conductor for the purpose of inspection or repair. At all 2300 volt installations, porcelain enclosed cut-outs shall be installed to disconnect all power from the equipment involved, this installation to be made at the location of the equipment.

Resistor Mounting. 4. Resistors shall be mounted on concrete bases or supported on pipe frame work so that the bottom of the resistor will be at least one foot from the floor and shall be 24 inches removed from the coal ribs so as not to present a fire hazard. All switches and disconnects shall be pulled before working on high voltage lines and all wires of the circuit shall be short-circuited and grounded.

Protection. 5. Resistors shall be protected with a suitable inclosing guard.

Insulation and Grouping. 6. Control wiring, unless installed in metal conduit, shall have slow-burning insulation or approved switchboard wire. All conductors composing such wiring shall be laid in groups so that they may be readily traced and identified. The use of wires having different colors is recommended.

Type of Wire Insulation. 7. Wires connecting resistors and controllers or controller panels shall have a slow-burning insulation. Wiring between motors and liquid controllers shall have rubber insulation.

Hoist Plans. 8. Plans shall be developed for each district so that each hoist, together with its complement of conduits, wires, cables, guards, floorplates, etc., may be removed in its entirety to new locations.

Panel Protection. 9. Primary contactor panels carrying 2300 volts shall have all live parts completely enclosed in a box of transite or asbestos board.

SWITCHBOARDS

Supports. 1. All switchboard frames shall be made of pipe or other metal supports with panels of incombustible material possessing insulating qualities suitable for the voltage carried.

Clearance. 2. Switchboards shall be given a three-foot clearance at the front, back, and ends.

3. Switchboards shall have a clearance of two feet from the floor.

Protection. 4. When the potential behind the switchboards exceeds 275 volts, the rear of the board shall be protected by gates and marked by appropriate signs.

Grounding. 5. All switchboard mountings, instruments, transformers, and instrument casings shall be grounded. (See section on grounding.)

Conductors Crossing. 6. Conductors shall not cross the passageways back of switchboards except below the floor or at a height of at least 6½ feet above the floor.

MOTOR-GENERATOR SET AND RECTIFIER ROOMS

Arrangement. 1. For general arrangement see Fig. 15.

2. Special attention shall be paid to location relative to load center in order that power may be distributed in two or more directions.

Ample Space. 3. Ample space shall be provided around the apparatus to permit easy handling in case of dismantling for repairs.

Disconnecting Switches. 4. All motor-generator sets and rectifiers shall be equipped with disconnecting switches similar to those in hoist rooms.

Location. 5. Rooms containing motor-generator sets, rectifiers, pumps, or hoists shall be ventilated with intake air at all times, and shall be located between intake and return air courses in order that fumes or smoke given off at times of burnouts may be diverted to the return air course.

Fireproof Doors. 6. Self-closing doors shall be provided at all motor-generator and rectifier rooms as shown in Fig. 15.

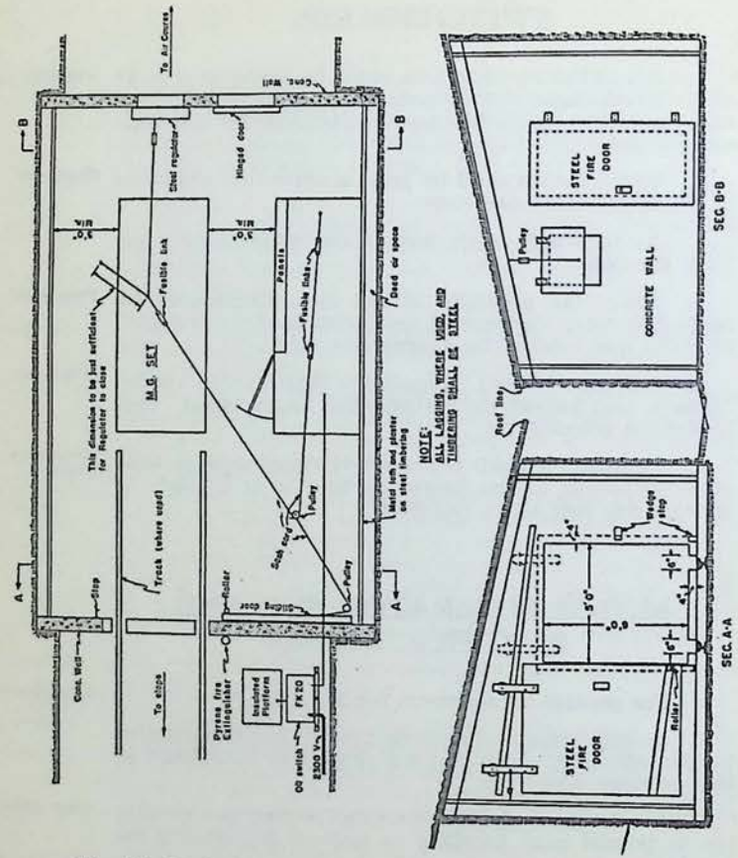


Fig. 15—Method of Fireproofing Motor Generator Set and Rectifier Rooms.

SHAKER LOADER INSTALLATIONS

1. For general arrangement and wiring connections see Fig. 16.

2. By "power circuit" is meant the two conductors carrying the load current of the motors. **Power Circuit.**

3. The Frame Ground Wire shall be connected only to the machine frames and the high side rail. The Rail Return Wire of the power circuit shall be connected to the low side rail and under no circumstances shall the Frame Ground Wire be connected to the Rail Return Wire. **Ground Connections.**

The Frame Ground Wire should carry no current unless the windings of a machine become grounded to the machine frame, in which case a man touching the frame will not receive a shock.

4. The power circuit and the frame ground wire may be installed over the entry track where there is sufficient height. The power circuit may be installed under the track providing wire with waterproof insulation is used and protected by the use of conduit which shall be continuous from the low rib to the switch stand and securely fastened at each end. **Conduit must be properly grounded.** **Installation.**

5. If frame ground wire is run on the bottom to the high side rail, it shall be so placed as to prevent any mechanical injury to the wire. Otherwise all wires and cables shall be properly fastened overhead to roof, props or cross bars with Fletcher hangers.

6. All wire connections and connections to rail bonds shall be made by use of "Servit" connectors, or equal.

7. The frame ground wire shall be securely bolted to the frames of switch stand, shaker drive, fan and material hoist, if used.

8. Trolley clamp, O.B. Cat. No. 14389 or equal, shall be used to fasten "hot" wire to trolley line.

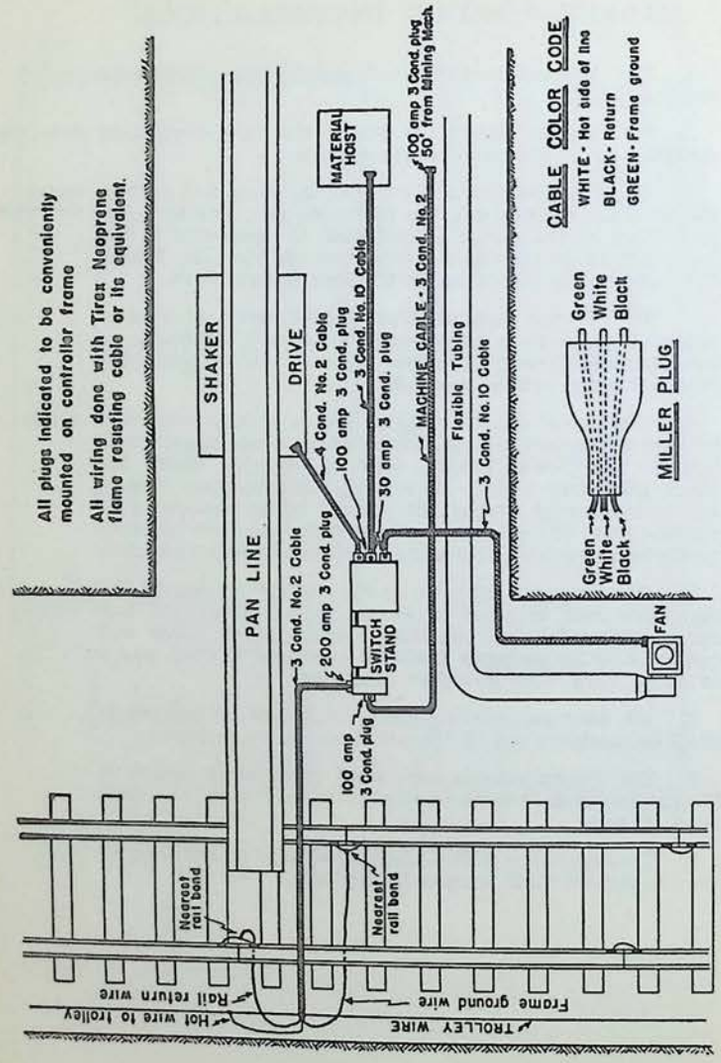


Fig. 16—Standard Method of Wiring Shaker Installations.

METHOD OF THAWING FROZEN WATER PIPES BY ELECTRICITY

1. No voltage higher than 220 volts shall be used. **Voltage.**

2. Equipment to be used shall consist of a Harold Electric Pipe Thawer requiring not more than 220 volts for the primary, nor more than 48 volts for the secondary. (See Fig. 17, Page 50.)

3. The equipment shall be connected to 220-volt service lines that are grounded in accordance with our Code of Standards as shown on Page 28. **Grounding.**

4. A double-pole, fused, enclosed type service switch shall be used to control the current to the thawing transformer and persons operating this switch shall make use of an insulated platform. **Use of Switch.**

5. All connections from the service switch to the thawing transformer and to the pipe lines shall be completed before the switch is closed. The switch must be "out" when handling any of the cables and when tightening or adjusting connections.

6. The work shall be done under the personal supervision of the District Electrician. **Supervision.**

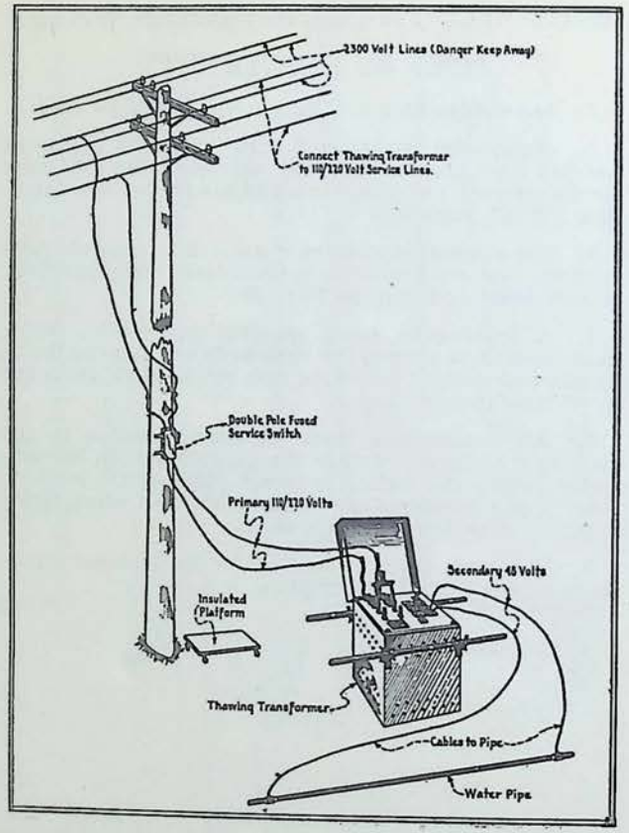


Fig. 17—Electric Pipe Thawer.

ELECTRICAL SAFETY PRECAUTIONS

1. An insulated platform shall be provided at all stations where it may be necessary to handle parts that are suspected of being alive or capable of giving shock. **Insulated Platform.**

2. Supply lines extending to remote parts of the mine where current is not required after the working shift shall be disconnected by a person delegated to perform this duty. **Cut Off Supply Lines.**

3. Working on live lines is prohibited. (See Rule 8, Page 7.) **Working on Live Wires.**

4. Before working on high-voltage lines, all wires of the circuit shall be short-circuited and grounded.

5. Standard caution notices shall be posted at such points as will render them most effective in reducing the likelihood of accidental contact with live electrical equipment and conductors. **Caution Notices.**

6. At each pump, hoist, fan or motor-generator set there shall be at least one Pyrene, or similar type, fire extinguisher. This shall be conspicuously marked that it can be used on live parts only when there is a noticeable air movement and then only from the intake side. Buckets of shale dust shall be kept at these places, the aggregate volume of which shall not be less than two cubic feet. **Fire Extinguishers and Shale Dust.**

7. No one but authorized persons who have the recognized capabilities shall be permitted to operate pumps, motor-generator sets, hoists or fans, and standard prohibitory notices to this effect shall be posted. **Authority to Operate.**

8. No person shall be allowed to work on or with electrical equipment of any kind unless authorized by the Mine Electrician. **Authorized Workmen.**

9. Trolley wires that are less than 6½ feet above the top of the rail shall be protected at all points where men are regularly required to work or pass under them, and at all points where the men may come in contact with the wires. **Trolley Wire Guards.**

10. Trolleys shall be carried on opposite side from the traveling ways. **Trolley Wire Opposite From Travel Ways.**

11. Light circuits shall not be installed in places known to generate gas. **Light Circuits in Gas.**

12. Electric lamps shall not be installed where they will come in contact with combustible material. **Electric Lamps.**

INSTRUCTIONS TO PERSONS INSPECTING ELECTRICAL EQUIPMENT

Ground Inspection.

1. Inspectors shall pay particular attention to ground connections and shall satisfy themselves, beyond doubt, that the ground connection will serve the purpose for which it is intended.

Concealed Grounds.

2. See that concealed ground wires are replaced by others that are visible throughout their length where possible.

NOTE: Parts that should be grounded are: Cable sheaths, conduits, oil switches and operating levers, transformer cases, motor frames, compensator and motor starting apparatus, metal boxes containing switches, resistors or control equipment, secondary circuits from transformers (except transformer secondaries supplying Rotary converters, Rule 14 Page 29), controllers, conveyors, conveyor machinery, pipe frames supporting switchboards and other equipment.

D. C. Generator Grounds.

3. Observe that ground wires from D. C. generators are properly connected to both rails of the track.

Conductors to be Guarded.

4. See that wires leading to motors or generators are properly guarded.

5. Examine oil switches and compensators for proper oil condition and for accumulations of coal dust.

Conductors Crossing Slopes, etc.

6. Inspect wires and cables that cross passageways and hoisting slopes, as these may become loose and present a great hazard. Light, telephone or signal wires across slopes may endanger persons or man trips.

Inspection of Automatic Appliances.

7. Determine that overload relays, automatic circuit breakers and undervoltage releases function properly.

Adjustments of Exciting Current.

8. Synchronous motors are operated with a fixed amount of exciting current at no load. See that the field adjustments are correct and that instruments indicate properly.

Voltage Adjusting on D.C. Generators.

9. Direct-current generators lose voltage upon becoming warm. See that someone restores voltage during the working shift.

Familiarize Self With Apparatus.

10. Familiarize yourself with the operation of all pumps, motor-generator sets and hoists in order to determine that all starting, stopping, controlling, and protecting equipment functions properly.

Report of Low Voltage and Additional Load.

11. Report to the Mine Electrician low voltage at any working place, or any extra load that is to be added to installed equipment.

Report Overload and Abuse.

12. Report all equipment overloaded, abused, or poorly ventilated, causing overheating.

Brushes, Bearings, and Air Gap Clearance.

13. Inspect electrical equipment when not in operation to determine condition of bearings, brushes, commutator and collector rings, and observe condition of revolving parts for loose band wires and dust accumulation; also test air-gap clearance between rotor and stator with an air-gap gauge.

Cable Inspection.

14. Inspect mining machine cables for bruised places and splices and see that they are adequately insulated with rubber and friction tape.

INSPECTION BY SAFETY ENGINEER AND CHIEF ELECTRICIAN

Standard Installation.

1. In order to better safeguard employes working around major electrical operations such as hoists, pumps, motor-generator sets, fan motors, etc., the following must be observed regardless of whether the installation is temporary or permanent.

Imperative.

2. All installations shall conform strictly to the established standards for such installations.

Red Tag.

3. The local Chief Electrician shall, while such equipment is in course of construction, tag conspicuously with a red tag, stating that such equipment is dangerous to operate.

Examination.

4. The Mine Superintendent shall notify the Chief Electrician and Safety Engineer of the completion of the work and they shall, without undue delay, each make a personal examination of the installation and shall certify to its safety by removing the red tag and substituting a white tag with this information thereon.

Taking Off Tag.

Certified Approval.

5. In no case shall the equipment be operated unless the installation is approved by the Chief Electrician and the Safety Engineer.

Penalty.

6. Failure of the district Chief Electrician to observe and comply fully with the above instructions will be considered sufficient grounds for dismissal from the service.

AUTOMOBILE INSPECTION AND REPAIRS

Automobile Inspection.

All company automobiles operating in the Rock Springs field (except at Superior) will be brought to the automobile shop in Rock Springs once each month for inspection by the Automobile Mechanic. Record will be kept by the Mechanic of date of inspection and record placed in a conspicuous place on the instrument board of the car so that operator may know date at which next inspection is due.

All repairs must be made in the company shop unless specific permission to the contrary is given by the Vice President, Operation. Monthly inspection of automobiles at Superior and Hanna will be made at the direction of the local Master Mechanic.

MAJOR DISASTER

Duties of Various Persons

I. In case of fire or explosion at any property the Mine Clerk at the property shall immediately:

1. Notify the general office at Rock Springs.
2. Call the men from other company mines in the district.
3. Station one man permanently at the mine office telephone.
4. Personally see the following men, whose duties shall be as hereinafter set forth:
   - (a) Mine Foremen of mines not affected. Senior Foreman shall be in authority, providing the Mine Superintendent is not present, until the arrival of some ranking official. (This implies that the Mine Superintendent might be a victim of the disaster.)
   - (b) Master Mechanic. Chief Electrician.
   - (c) Outside Foreman.
   - (d) Carpenter.
   - (e) Doctor.
   - (f) Hotel man.

II. Mine Foreman.

1. Place guard at Mine Entrance.
2. Erect barrier about mine entrance enclosing sufficient area and needed mine buildings.
3. Proceed to enlist and organize rescue and exploring parties.
4. Immediately designate two persons to act as checkers and searchers of the men who are to enter the mine, and to keep a record of the men so entering with their time of entrance and exit.
5. Appoint a competent man to be stationed at mine entrance to make an examination of all flame safety lamps before they are taken into the mine.
6. Pending arrival of Vice President, Operation or General Manager, arrange to have authoritative bulletins and information given to representatives of the press and the community.

III. Outside Foreman.
1. Station man at all surface telephones.
2. Assemble trucks or teamsters, who shall stand in readiness to bring material needed.
3. Prepare buildings, preferably near mine mouth and within enclosed area for:
   (a) Base for rescue crew and repairs to apparatus.
   (b) Temporary morgue.
   (c) Conference room for officials.
   (d) Rest room for rescue crews and crews awaiting call.

IV. Carpenter.
1. Assemble all tools as outlined on blue print in carpenter shop.
2. Erect barriers and temporary shelters at the direction of the Mine Foreman or other person in authority.

V. Master Mechanic.
1. Thoroughly examine fan and provide against overloading motor or transformers due to short-circuiting of air.
2. Look to the water supply, pipe lines, and other fire-fighting equipment.
3. Closely supervise boiler plant and surface pumps.
4. Arrange for water supply from all possible sources in the event of failure of usual supply lines.

VI. District Electrician.
1. Cut power off underground portion of mine.
2. Thoroughly examine fan and provide against overloading motor or transformers due to short-circuiting of air.
3. Station a competent man at the fan.
4. Keep close supervision over power plant.
5. Provide telephone communication between important surface points and prepare portable set for underground extension with sufficient wire for advance.
6. Provide sufficient electric cap lamps and proper means for charging and distributing same.

VII. Local Doctor.
1. Call such help as he may deem necessary, and assemble emergency medical supplies.

VIII. Hotel Keeper.
1. Provide for billeting rescue crews in places remote from the activity.

2. Make preparation to serve all meals and establish a lunch station at or near the mine.
3. Prepare and keep in reserve all rooms for the service of those men who are brought in or have come to give assistance.

IX. General Offices at Rock Springs.
1. Vice President, Operation and General Manager repair immediately to the disaster, taking the Supervisor of Ventilation and the Chief Engineer, together with ventilation map and data, and available maps of the mine. Notify peace officers, who will assist in keeping spectators from interfering with rescue work.

X. Safety Engineer.
1. Notify the several Mine Superintendents, who shall immediately assemble their mine rescue and first aid crews, together with apparatus, oxygen containers, pumps, etc., and proceed by the speediest possible method to the disaster.
2. Notify U. S. Bureau of Mines and State Chief Mine Inspector.
3. Assemble apparatus of Rock Springs central station, together with oxygen supply and dispatch the same.
4. Prepare for the transportation of such doctors and nurses as are necessary.

XI. Material for Local Carpenter to assemble and take to the Mine:
1. Hammers, trowels.
2. Nails (various sizes), 8, 16 and 20d.
3. Axes, picks, shovels.
4. Saws, sledge hammers, pipe wrenches and tongs.
5. Hoes (mortar), cold chisels.
6. Shovels.

XII. Material for Outside Foreman to assemble and transport to mine:
1. Lumber (ship lap) for stoppings (2,000 feet, board measure).
2. Canvas gloves.
3. Brattice cloth.
4. Bricks.
5. Tile.
6. Cement.
7. Sand.
8. Portable fire extinguishers.
9. Chalk.
10. Fire hose and pipe, with reducers and valves.
11. Buckets.

NOTICE: No intoxicating liquors whatever will be permitted at or near the scene of disaster.

MINE RESCUE APPARATUS AND TRAINING

Location. 1. The mine-rescue apparatus for the Rock Springs field will be concentrated at Rock Springs.

Handling and Use. 2. No crew will be allowed to enter the rescue building and take, use or handle any apparatus unless the person having charge of the apparatus is at hand.

Reserve Rescue Crew. 3. No rescue crew will be allowed to enter any mine to do actual rescue work unless a reserve crew is on hand with machines and equipment to lend assistance if necessary.

Apparatus Inspection. 4. All apparatus shall be thoroughly gone over not less than twice each month, and each machine or piece of apparatus shall be tested, examined and a tag attached thereto giving date of examination and the condition of that particular machine or piece of equipment.

NOTE: Any recent repairs made, such as new breathing bag, tubes, etc., must be noted on the attached tag in order that the person wearing apparatus may be on the alert for loose gaskets or connections in the new parts when the machines are first worn.

Quantity of Oxygen. 5. There shall be on hand at all times not less than 800 cubic feet of reserve oxygen (7 containers).

Report. 6. A monthly report of apparatus will be made by the person caring for this equipment, one copy to be sent to the General Manager and one to the Safety Engineer.

NOTE: This report must cover recent repairs, supplies on hand and condition of machines (each machine to be designated by a number).

File Of First-Aid and Mine Rescue Men. 7. The Safety Engineer shall keep a readily accessible file of all men employed by the company who have received first-aid or mine-rescue training.

Record of Training Given. 8. A record of the men and the training they have received at the local mine-rescue station shall be kept by the person in charge thereof.

Record of Certified New Employes. 9. A record of all men to receive training, or those entering the employ of the company who have had previous training, shall be filed with the Safety Engineer.

Physician's Examination. 10. No man shall be trained in mine-rescue work without a physician's certificate showing that he has a sound heart and normal blood pressure.

GENERAL SAFETY RULES

Minors and Females Not Allowed.

No male person under 18 years of age nor any female person, will be allowed to enter the mines of this Company as a visitor. Males over 18 years must obtain permission to enter mines from the Superintendent in charge.

Smoking in Mines.

1. Smoking or the carrying of any smoking or flame producing materials is prohibited in all mines operated on a closed light basis.

Penalties For.

Sec. 23-113, Wyoming Compiled Statutes.—"Any miner, workman or other person who shall * * * carry any pipe, cigar or cigarette, match or fire producing material or appliance into places that are worked by safety lamps * * * shall be deemed guilty of a misdemeanor and may be punished in a manner provided in Sec. 23-131." This section provides a fine of not less than $200.00 and not more than $500.00 at the discretion of the court.

Search For Matches, Lamp Keys, Etc.

Sec. 23-138, Wyoming Compiled Statutes.—"Any man working in a mine or mines where safety lamps or electric lamps are used exclusively shall be subject to search by the Mine Foreman or his assistants for matches or other flame producing devices * * *. No person shall have in his possession in any part of a mine where closed lights or locked safety lamps or other similar devices are used, any matches or means of producing fire, or any lamp key or instrument for the opening of a light or lamp." Sec. 23-142 provides that any person or corporation violating any of the provisions of the above section shall be guilty of a misdemeanor and subject to a fine not to exceed two hundred dollars ($200.00).

Checking in and out of Mine.

2. All persons entering the mine must be checked in and out of the same, and every person while underground must have his life check on his person and in his right hand front trousers pocket.

Life Checks.

3. Each man's life check shall correspond to that of his lamp, which may be independent of his "payroll" number. A list with the name of the man and the number of his life check shall be posted at the lamp house and the life check number of each man will not be changed during the time a man works in a given mine.

Dust Barriers.

4. All mines shall be protected against explosion propagation by rock-dust barriers. These barriers shall conform in plan to Figs. 18 and 19.

NOTE: In places where clearance is unattainable or where it is deemed impractical to support dust barriers by props, they may be suspended from the roof by proper eye bolts. Where barriers are set into the roof, vanes shall be placed on either side of same to deflect the air currents into them.

Location.

5. Dust barriers shall be located on all slopes, air courses, and manways intermediate of all cross entries as shown in Fig. 20.

Additional Dust Barriers.

6. In any place where complete protection is not afforded by the foregoing, additional districts shall be established which shall be sectionalized by dust barriers in a manner similar to the foregoing and subject to the approval of the Safety Engineer.

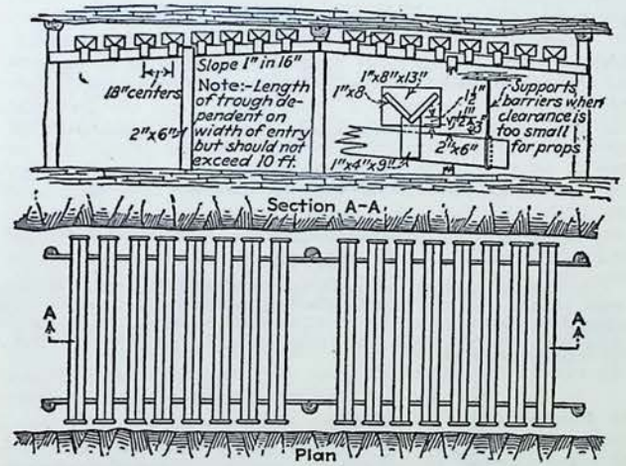


Fig. 18—Dust Barriers Stop Blasts.

The arrangement of these troughs varies. When the clearance in the gangway is limited they are hung from the roof on eye bolts, as shown in the illustration.

Dusting.

7. Slopes, panels, entries, haulageways and traveling ways shall be rock dusted in a manner prescribed by, and subject to the approval of, the Safety Engineer, which, however, shall be in a manner now or hereafter approved by the United States Bureau of Mines and the Chief State Mining Inspector.

Cover Machinery While Rock Dusting.

8. During the course of rock dusting, all machinery within the mine shall be adequately protected by burlap or other covering to keep the dust from settling upon the machinery.

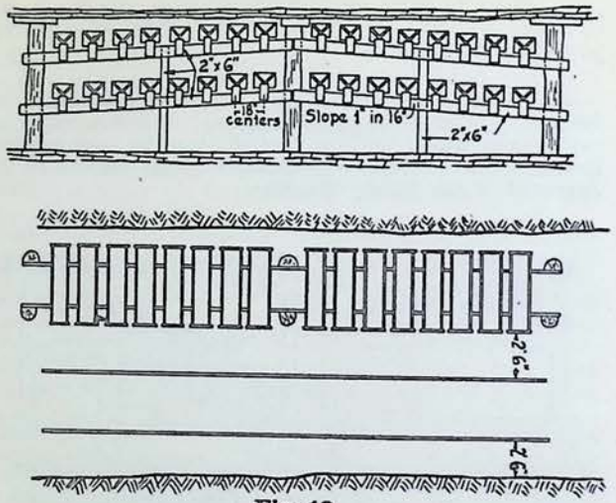
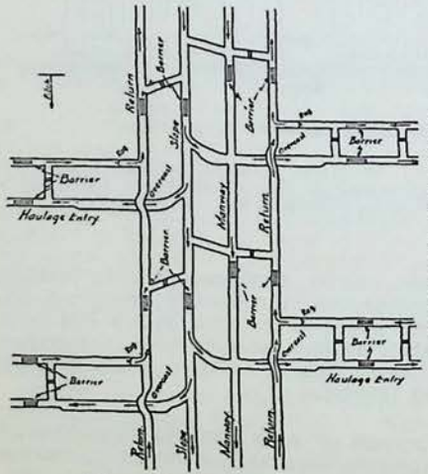


Fig. 19

Alternate method of placing rock dust barriers where roof height will not permit placing as shown in Fig. 18. The length and number of the troughs shall be such that the battery will contain rock dust equivalent to the standard 9-ft., 16-trough barrier.



Complete sectionalization must be attained by dust barriers on slopes, manways, returns and cross entries, as illustrated. Whenever explosions occur the aim should be to completely isolate them and thus minimize all danger to adjoining sections.

Fig. 20—Blockades Against Explosions.

9. All mechanical haulage shall be provided with efficient head and tail lights. **Lights On Haulage Trips.**

Sec. 23-115, Wyoming Compiled Statutes.—"Each locomotive employed in underground haulage in a coal mine shall be equipped with an efficient gong and with an efficient head light, both of which shall be maintained in good operating condition. Motormen must use the headlight and gong in a way to effectively warn employes in the mine of danger. When mine cars are pushed by a locomotive underground, an efficient trip light, maintained in working order and kept lighted, shall be carried on the front end of the forward car in a position where it can be plainly seen by the employes ahead of same. When loaded or empty mine car trips are being pulled by locomotives through entry or haulageways an efficient trip light, maintained in working order and kept lighted, shall be carried on the rear end of the last car at all times, except when trip rider is riding the rear end of the last car. A marker board, with an area of not less than one square foot, painted white and kept clean for visibility, may be substituted for the trip light on the rear car of trips which are being pulled by locomotives; provided, however, that this section shall not apply to the gathering of cars or to any hauling of cars in a mine except haulage on main entries."

NOTE: No trip marker other than a red electric light will be permitted or used in the mines of The Union Pacific Coal Company, the same to be carried on the advancing end of all slope trips.

10. Rope runners shall see that, on trips devoted to the hoisting or lowering of men, no one is permitted to ride unless he is seated. Overcrowding of man trips is absolutely prohibited. Persons boarding or getting off man trips while in motion subject themselves to discharge. **Man Trips and Passengers.**

11. Sec. 23-133, Wyo. Compiled Statutes. "* * * And such train of cars known as 'man-trips' shall not be run at a greater speed than five (5) miles an hour. When tools are carried on 'man-trips' they shall be carried in a separate car provided for that purpose and it shall be a violation of the law for any miner or other person to carry his tools except as herein provided." **Man Trip Speed.**

12. When men are being lowered or raised at the beginning or end of a shift, the hoisting engineer must have an assistant on the platform. It will be the duty of the hoisting engineer in charge when the man trips are raised or lowered to see that an assistant is present on the platform before he attempts to raise or lower the man trips. Men regularly employed in this capacity are to be examined during each twelve months period. **Hoisting Engineer's Assistant.**

13. **Before man trips are raised or lowered, the rope-runner shall make an examination the complete length of the man trip, assuring himself that all couplings, pins, safety cables, etc., are functioning properly. Once each month a complete examination of the man trip shall be made by the machine boss. He will state on his monthly report of machines that this has been done, noting thereon any defects found and the corrective measures that were taken.**

Travel On Slopes.

14. No employes, unless in the course of duty, will be permitted to travel slopes or haulageways where there are manways provided, and any violation of this rule will subject the person so offending to discharge.

Riding On Trips.

15. No person other than the rope rider and haulage boss shall be permitted to ride a loaded trip.

Disposition of Slope Trip When Idle.

16. No main or panel slope trip shall be allowed to stand on the slope or panel at the end of a shift. The trip should be placed on a parting off the slope.

Safety Gates.

17. Wherever a traveling way crosses a main haulage way, there shall be installed gates that will swing inward and away from the haulage way. These gates shall be provided with springs or weights, which will make them positive in closing. (See Fig. 21.)

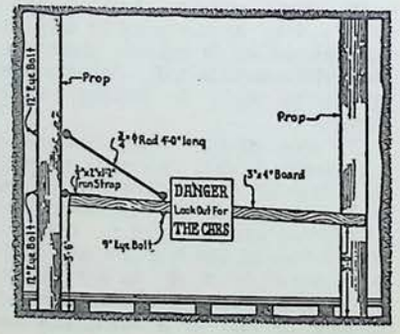


Fig. 21
Danger Warnings.

Where travelways enter upon or cross main haulage roads, gates which swing away from the main road must be provided. These gates will be hung either so that they close of their own weight or are assisted by a spring.

Refuge Holes.

18. Man, or refuge holes at entry switches on main haulage slope will be as shown in Fig. 22. Manholes shall also be provided at all heading switch throws upon which haulage is mechanically operated.

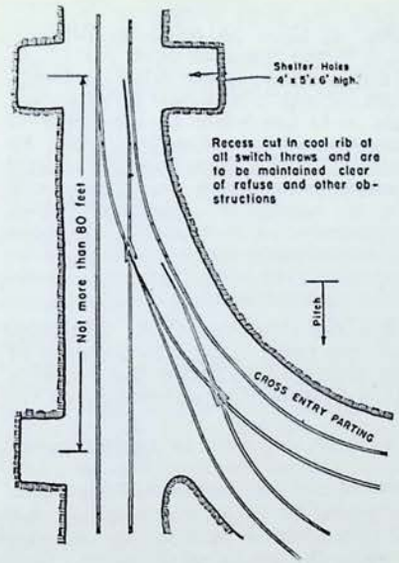


Fig. 22
Refuge Holes Along Haulageway.

Recesses will be cut in the ribs of the gangway at switch points on main slopes to provide a refuge place for rope riders and others.

Trolley Wire Guards.

19. At crossings of all regular traveling ways and locomotive haulage roads, and on partings, the trolley wire shall be protected by guards which shall be supported in the manner shown in Fig. 23.

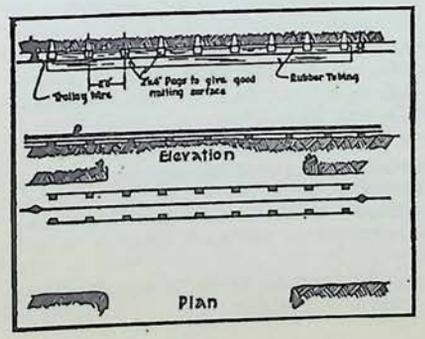


Fig. 23

This method of protecting trolley wires will be used where a travelway crosses under a trolley and also at partings.

Control and Removal of Fire Damp (CH4 Methane.)

20. Sec. 23-108, Wyo. Compiled Statutes.—"Control of Fire Damp—Penalty. It shall be unlawful for any miner, fire boss, employe in any mine, or other person, to brush fire damp from any place in a coal mine by means of a coat, sack, sail cloth, or any like article or material; or by any other means; or to use water for the removal of fire damp, and any person so offending shall be deemed guilty of misdemeanor, and upon conviction shall be imprisoned for a term not exceeding six months, and fined in any sum not to exceed one hundred dollars ($100.00). And any owner or superintendent, mine boss or fire boss, who shall knowingly permit the same to be done, shall be deemed guilty of a misdemeanor, subject to the same penalties as hereinbefore prescribed."

(a) In case explosive gas (Methane, CH4) is discovered at any point within the mine, it shall be the duty of the person making the discovery to report the same to the Fire Boss or Mine Foreman, who shall arrange for its removal.

(b) No body of gas shall be moved by anyone except under the personal supervision of the Mine Foreman and after the Superintendent of the district has been notified.

(c) No person or electrical apparatus, between the gas and return, is to be permitted to work or operate, or have the power on while the gas is being moved. (See ventilation section.)

Type Of Explosives.

21. No explosive except one designated as "permissible" by the United States Bureau of Mines shall be used in any mine.

Quantity of Explosives.

22. No man shall have in his possession at any time, more explosives than will be sufficient for one day's blasting.

Storage of Explosives.

23. Any explosives in the possession of the miner must be stored in a suitable box, which shall have the approval of the Safety Engineer. This box shall be kept at least 100 feet from the working face, preferably in a crosscut, and not in direct line with the working face.

24. In mines operating on a company basis (Mechanical Loading) the explosives for the shift shall be placed in a locked wooden box in a suitable, convenient and safe place and the Foreman and Shot Firer only shall possess keys to the same.

Segregation of Explosives, Detonators, Tools, etc.

25. The storing of explosives and detonators together, or both or either of these with spikes, nails, tools, or other metallic substances is positively prohibited and subjects the person responsible for such storage to discharge.

Transportation of Detonators.

26. Electric detonators shall be brought into the mine in a small portable leather container.

Shot Firing Wire.

27. Only rubber-clad cable of a distinctive color shall be used to connect the blasting machine to the detonating cap or caps, and this cable must be not less than one hundred and fifty (150) feet in length at all times. Cable reels are to be provided and the cable kept on reel when not in use.

Cable Reels.

Premature Blasts.

28. In order to better obviate premature blasts and minimize stray currents, all power and lighting lines shall be cut off from each mechanical loading unit before any shot holes are charged. When Shot Firers are engaged in the work of firing shots, the shot-firing cable must be disconnected from the blasting machine and the cable leads must be short-circuited at the blasting machine before connection is made to detonating cap or caps at the face, and all employes other than the one connecting the cable to the cap at the face are forbidden to handle the blasting machine while the work of firing shots is being carried on. When Shot Firers are connecting the cable to the shot wires at face, either the battery or the battery key **MUST BE** in the personal possession of the Shot Firer.

Tamping Material.

29. All holes shall be tamped with clay, rock dust or other incombustible material, which will be furnished at a convenient place to the employe by the Mine Foreman.

NOTE: See safety precautions in regard to explosives.

Loading of Bug Dust.

30. Where coal is loaded mechanically and water is used on cutter bar of mining machine, the face may be shot without first loading out the bug dust, providing: (a) that the dust is thoroughly wetted down within thirty minutes preceding the firing of shots; (b) that the work of shot firing is conducted under the immediate supervision of a competent Mechanical Loading Foreman. It will not be necessary to use water on cutter bars or to wet down machine cuttings in places where the natural moisture is sufficiently heavy, the Mine Foreman or his assistant to determine all exceptions to the rule.

Non-Metallic Tamping Bar to be Used.

31. No person in the employ of The Union Pacific Coal Company, while loading or charging a hole with nitroglycerine, or permissible powder, shall use or employ any steel or iron tamping bar, nor shall any Superintendent, Mine Manager, Foreman or Shift Boss, or other person having the management or direction of employes, allow or permit the use of such steel, iron or other metal tamping bar by employes under his management or direction. The type of tamping bar which shall be used for the above purposes shall be made entirely of wood.

Water On Cutter Bars.

32. Cutter bars of all mining machines must be equipped with hose and water, and the water used while machine is in operation. (See Rule 30.)

Water Lines.

33. Water lines shall be extended to all working faces in the mines.

First-Aid Material.

34. First aid material shall be kept at all hoists and at such other places as may be designated by the Mine Foreman or the Safety Engineer. In every working entry there shall be at least one complete first-aid unit located at a central point.

Blue Light or Sign at First-Aid Kits.

35. The locations of all first-aid outfits shall be designated by the presence of a blue light. When a light cannot be installed, a suitable sign will be used.

Responsibility for First-Aid Outfits.

36. It shall be the duty of the Mine Foreman to see that first-aid outfits are kept supplied with all necessary material and that they are in good condition at all times.

37. Provision for the care of injured persons shall be made in accordance with the following:

Blankets, Bandages.

"There shall be at each mine sufficient blankets, oil, bandages, cots, etc., readily available to properly care for and convey injured persons to their homes or the hospital after an accident; said equipment to be kept in a dry place. Rooms suitable for the care of injured shall be provided at each mine by the Company. Suitable ambulance service shall be furnished for all mining districts."

Blanket Storage Within Mine.

38. When blankets and pillows are stored within the mine together with the stretcher, suitable provision shall be made for keeping the same in a dry and serviceable condition by storing in galvanized-iron boxes. which may be heated by placing an electric lamp therein.

Safety Device for Panel Sinking.

39. All men working in slopes, rooms, or other places being driven to the dip shall be protected by a safety device such as shown in Fig. 24.

Guards on Machines.

40. No machinery of any kind will be allowed to operate unless all gears and other dangerous parts are fully guarded. The cutter chains of mining machines shall be locked securely to prevent accidental movement while being trammed.

Persistence In Dangerous Practices.

41. Any miner or other workman who is habitually found working in dangerous places due to laxity in properly timbering, or otherwise making himself safe, subjects himself to discharge.

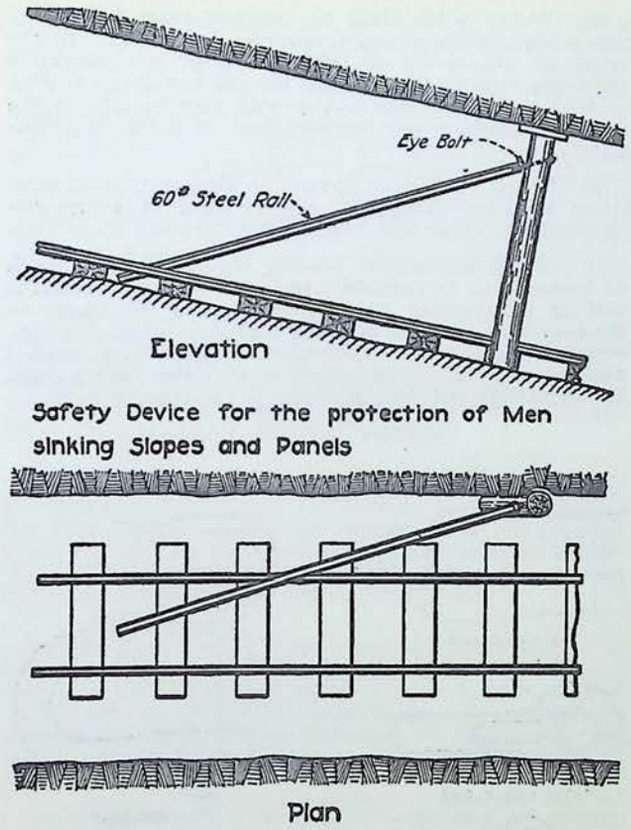


Fig. 24—Slope and Panel Safety Device

Waste Receptacles.

42. At all hoist rooms, pump rooms, motor-generator sets, etc., where it is necessary to keep waste, two receptacles shall be provided, one for clean waste and one for waste that has been used. These receptacles shall be of metal with tight lids, lids to be self-closing.

Trips Hanging On Ropes.

43. No empty or loaded trip will be permitted to hang on the hoisting rope over night, or at any time when the Hoisting Engineer is not on duty and present in the hoist room.

Trolley Poles On Power Lines.

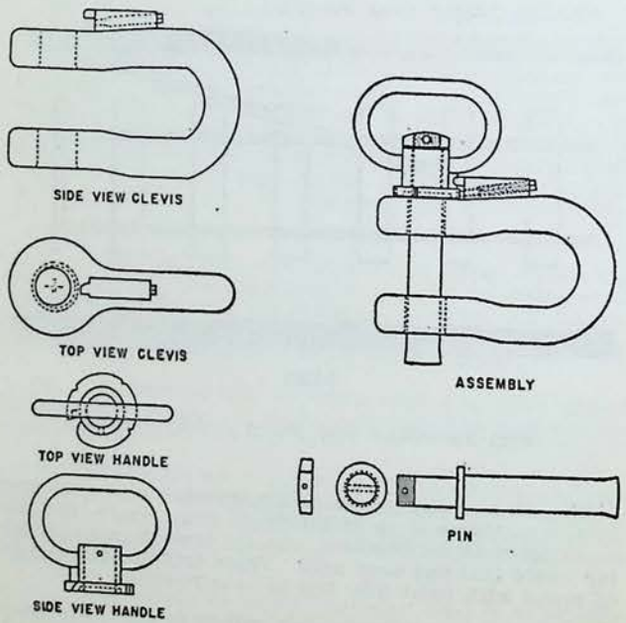
44. Trolley poles must be removed from the trolley line when the Motorman leaves the locomotive. In the event of derailment or other accident to locomotive operation making it necessary for the motorman to flag or seek assistance, the trolley pole may be left on the wire to provide power for headlight, to warn other employes.

Pyrenes at Loading Stations.

45. There shall be a Pyrene or similar type of electrical non-conducting fire extinguisher, at every mechanical loading station. (See Rule 6 Page 51.)

Hooks For Car Trimmers.

46. At all mechanical loading stations, a steel hook or device shall be furnished each car trimmer so that it will be unnecessary for trimmer to put his hands on the coal while the car is being loaded or while the conveyor is running. All underground supervisory officials shall see that this hook is used at all times during loading operations and that trimming is not done by hand.



SAFETY CLEVIS AND PIN

Fig. 25

47. The safety clevis pin shown in Fig. 25 will be used to fasten all hoisting ropes to empty and loaded trips.

Bore Holes to Be Placed Ahead of Work In Approaching Old Work.

48. Sec. 23-139, Wyo. Compiled Statutes, provides that: "bore holes shall be kept not less than twelve (12) feet in advance of the face of every working place, and when necessary on the sides of the same when they are being driven towards and in dangerous proximity to an abandoned mine or part of a mine, suspected of containing inflammable gases, or which is inundated with water."

In no instance will a less measure of protection be employed than called for by the State law, and when the conditions are presumed to be extra hazardous, the Superintendent will confer with the Safety Engineer, checking all mine maps carefully before proceeding with the work of approaching doubtful territory.

Notification of Relatives in Case of Injury.

49. In case of serious accident or death to any employe, it shall be the duty of the Mine Superintendent to see that the relatives of the injured party are immediately notified. He shall use his own discretion as to who shall act as informant, but it is mandatory that he see that such information be immediately given.

Notify Chief State Mine Inspector, Coroner and Others In Event of Explosion or Fatal Accident.

50. In the event a fatal accident occurs within or without the mine, the Mine Superintendent shall immediately notify the general office at Rock Springs. It will be the duty of the Safety Engineer (in his absence, the General Manager or Vice President, Operation) to immediately notify the coroner and Chief State Mine Inspector of the accident.

Telegraphic notice, with brief statement of details, covering all fatal accidents should be given to the President's office at Omaha, wire report to be followed by a complete detailed written report.

In the event an explosion occurs, whether from the ignition of explosive gas or coal dust, or both, and whether or not a fatality results from same, prompt notice will be given the Chief State Mine Inspector and no change in the general conditions, other than those absolutely necessary for the safeguarding of life and property, shall be made by the Mine Superintendent until the Chief State Mine Inspector or his deputy is given the broadest opportunity to examine the mine in the vicinity of the point where the explosion took place.

USE OF FLAME SAFETY LAMPS

Keep Safety Lamps Lighted.

1. Due to the general use of electric lamps and the absence of open lights in the mines, all men whose duty requires that they carry a flame safety lamp, viz., Mine Foremen, Safety Inspectors, Gas Watchmen, Shot Firers, etc., shall have these lamps with them at all times while in the mine and the lamps shall be lighted.

Check of Flame Safety Lamps.

2. The Mine Superintendent shall check safety lamps at frequent intervals to see that the magnetic locks have not been tampered with, and that said lamps are in condition to perform the duty intended.

Penalty.

3. Any failure to comply with the above regulations will subject the offending official, for the first offense, to a thirty-day suspension without pay, and, for the second offense, to discharge from the service.

Storage of Naphtha.

4. Naphtha or other flammable liquid in lamp houses shall be kept in approved containers or other safe dispensers.

Checking of Lamps.

5. Flame safety lamps shall be permissible and maintained in permissible condition. All flame safety lamps shall be checked by the persons using them, by a qualified lamp attendant, or by a fire boss, immediately before entering the mine.

Supervision.

6. When not in service, flame safety lamps and electric cap lamps shall be under the charge of a responsible person.

SAFETY PRECAUTIONS TO BE TAKEN WITH FLAME TESTING LAMPS, TOGETHER WITH NAMES OF THE VARIOUS PARTS

Fig. 1.

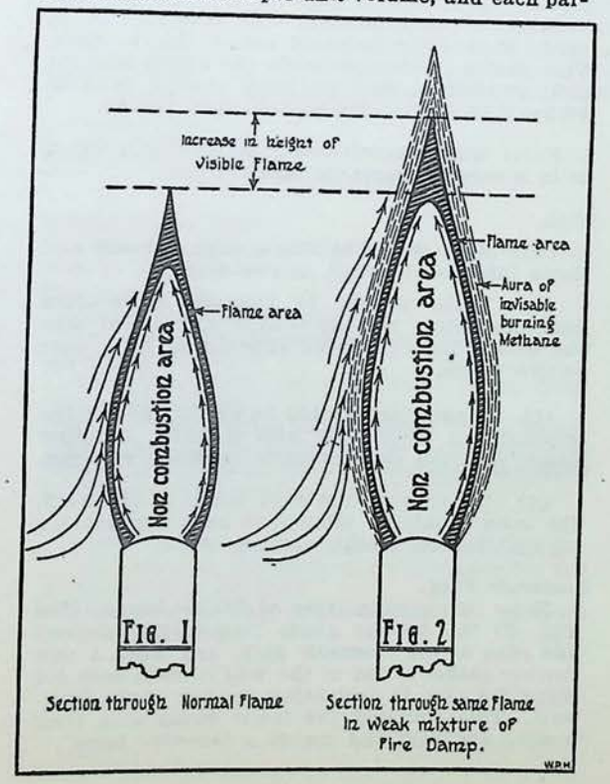
Section of standard traveling flame in normal atmosphere.

Fig. 2.

Same flame as Fig. 1, elongated slightly by an introduction into a weak mixture of fire damp (CH_4). The elongation is due to the following:

(a) An addition of combustible matter to the flame, increasing its volume.

(b) The gaseous mixture contains slightly less oxygen content per unit volume, and each par-



ticle rises somewhat higher than in normal flame before becoming incandescent, the above phenomenon being called "the search for oxygen."

(c) The temperature within the lamp is increased and the upward velocity of the burning gases is slightly increased, tending to elongate the flame.

Fig. 3.

Section through Wolfe flame testing lamp (the type most commonly used in the United States). Starting at the bottom of the drawing and working upward, the lamp consists of the following parts:

Reservoir.

Reservoir-Change Cotton.

(a) This is to be filled with about 2/3 of an ounce of specially prepared cotton, laid in rings. This should be changed when the cotton becomes dirty or gummy, and no lamp should be used longer than six months without such change.

Note: The reservoir also contains a wick which is in a separate movable tube.

Wick.

Wick, Care of and Changing.

(a) Wick should be long enough to reach well down into the reservoir, and no more.

(b) Wicks should be changed more often than the cotton. A lamp used constantly for testing should have the wick changed at least once in two weeks.

(c) A new wick should be put in dry and the exposed end burned off with a match or other flame, then the charred parts carefully removed.

(d) To trim an old wick while in the lamp, the lamp should be allowed to burn dry and the charred end thoroughly scraped off.

Reservoir Plug.

Reservoir Plug.

Note: On certain types of Wolfe Lamps (See Fig. 3) the bottom gauze ring extends beyond the edge of the reservoir plug, and when a new leather gasket is put in the well it often does not allow the plug to seat below the top of the reservoir. This prevents the lower gauze ring from sealing gas tight and makes a defective lamp.

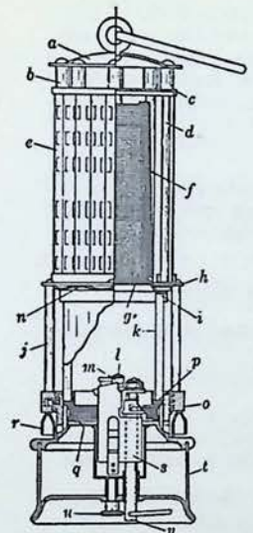


Figure 3—The American Wolfe lamp. — a, Hood (steel); b, spacers (steel, 5); c, upper ring (steel); d, stay screws (steel, 5); e, corrugated bonnet with ventilating slits (brass); f, outer gauze (steel); g, inner gauze, (steel); h, middle ring (steel); i, asbestos washer; j, standards (brass, 5); k, glass; l, round wick; m, wick tube (brass); n, expansion ring (steel); o, lock ring (brass); p, asbestos washer; q, inlet ring with double gauze (brass); r, air-inlet shield ring (brass); s, relighter; t, fuel fount, cotton filled (steel); u, wick adjuster; v, relighter operating handle.

Fig. 3—Wolfe Testing Lamp.

Bottom Gauze Ring.

Bottom Gauze Ring.

(a) This should be inspected for bends and breaks in the gauze.

Expansion Ring.

Expansion Ring.

The purpose of this part is—

(a) To even the compression on the glass at all times.

(b) To cushion the glass from shock when dropped or struck.

Note: This ring is often omitted or put in upside down. Either mistake makes the lamp defective, as the glass is almost certain to be broken if the lamp is dropped or struck.

Gaskets.

Gaskets.

Note: Top and bottom gaskets the same.

(a) Gaskets should form an even seat for the glass, which is gas tight.

(b) Gaskets that are torn or thick in spots must not be used.

(c) The practice of piling two and three gaskets on top of one another to make the lamp gas tight should be avoided. In case such a procedure seems necessary, it is an indication that the glass is too short. Another glass should be secured.

Glass.

Glass.

(a) Glass should be cut absolutely square, in order to insure an even seat and make the lamp gas tight without placing uneven stresses upon the glass.

(b) It should be uniform in thickness.

(c) It should be free from sand spots and air bubbles.

Gauzes.

Gauzes.

(a) In assembling the lamp, the outer and inner gauze must not be placed in such a way that the seams in the gauze will come together.

(b) Distorted gauzes, even though in otherwise good condition, must not be used. The spacing intended by the manufacturers should be maintained between the two gauzes.

(c) The gauzes must be kept clean, allowing no accumulation of dust or soot upon them.

Bonnet.

Bonnet.

(a) The bonnet must not be allowed to become dented. The vents and spacing from the gauzes should be maintained as intended by the manufacturers.

Standards.

Standards.

(a) A bent standard should not be used as this throws uneven stresses upon the glass.

Relighting Device.

Relighting Device.

(a) Be assured that the device is clean and in a working condition.

SAFETY LAMP PRECAUTIONS

(1) A safety lamp should never be opened underground.

(2) Be sure that you have retired to fresh air before attempting to relight a safety lamp that has been extinguished by an explosive mixture.

(3) When your light has been extinguished by a bump or fall never attempt to relight it until you have carefully examined it to see if any part is broken.

(4) Never play with your lamp in gas. Every time a flame is introduced into a gaseous mixture, it constitutes a separate risk.

(5) Always carry your lamp lighted while in a mine.

(6) A safety lamp is delicate. It is not made for sounding roof.

(7) Always hang up your safety lamp where men are working about, otherwise it is sure to be upset.

(8) See that your lamp is filled properly - **Not too full.**

(9) Use only a high grade of fuel.

(10) Never take your lamp into a high velocity air current which is liable to contain gas.

(11) Only an experienced or certified person should be allowed to take a lamp near a large body of gas.

(12) Be sure your lamp has no defects.

(13) Your "safety lamp" is a **testing lamp,** not a safety lamp. It is only safe when hanging in the rack in the lamp house outside the mine.

SPECIAL

It must be understood that the care, maintenance, and use of the safety lamps apply not alone to known gaseous mines, but to all mines, and the Safety Engineer will personally see that the foregoing regulations are observed.

GENERAL SAFETY PRECAUTIONS

(1) Keep all tools properly stacked or in racks where workmen will not have to walk over them.

(2) Spikes, nails, machine bits and tools, should never be driven in a prop.

(3) Nails sticking up in boards are a hazard. Extract or bend them over.

(4) Report to your supervisors what you consider unsafe conditions.

(5) Never work under loose coal or rock.

(6) Always be careful with explosives and detonators.

(7) Use the proper amount of explosives.

(8) Where mining machines are used, bore holes in the coal shall not be drilled beyond the back of the cut, nor into solid rib, roof, or floor.

(9) Electrical equipment is not to be tampered with.

(10) Avoid taking unnecessary chances.

(11) Observe all safety rules. They are not to be violated.

(12) Never leave doors or curtains open when they are supposed to be closed or vice versa.

(13) Unsafe practices are not to be tolerated or countenanced by others.

(14) Mark and report all broken bonds. (It may save a life.)

(15) **Always provide and maintain proper clearance between props and track.** (See Page 125).

(16) Keep all working face areas well sprinkled.

(17) A shovel is not your only necessary tool. Get a good saw, ax, and bar; keep them in good condition and use them.

(18) Explosive gas (CH_4) is dangerous. It is not to be tampered with.

(19) Upon the discovery of gas, report it immediately to your foreman.

(20) Authority for moving gas must be obtained from the mine foreman or fire boss.

(21) See that you have your life check before entering the mine.

(22) Instruct each new employe of the dangers incident to his work and working place.

(23) Secure permission before riding on empty or loaded trips.

(24) Only authorized persons are allowed to enter old workings. (Stay in your own working places.)

(25) Permission must be granted before visitors or strangers are taken into a mine.

(26) Travel on the man ways. Keep off slopes and planes.

(27) Always report faulty equipment or equipment not properly safeguarded.

(28) The floor of your working place is not to be littered with mining refuse and tools. Keep your working place neat and orderly.

(29) Workmen are not to congregate on partings or haulage ways.

(30) Tools are not to be carried with you on man trip. Tool cars are provided.

(31) Always avoid standing in the bight of a rope or chain in tension.

(32) Keep from under the trolley wire when riding trip.

GENERAL RULES AND REGULATIONS TO BE OBSERVED IN THE USE AND HANDLING OF EXPLOSIVES

1. All powder must be stored in well-constructed rock or concrete magazines on the outside, the location of which shall not be less than 1,000 feet from any dwelling house.

2. Detonators must be stored in separate, well-constructed, fireproof buildings, not less than 50 feet from a powder storage magazine.

3. All powder shall be taken into the mine in a specially-constructed powder car, of standard design. This car shall be made of wood, and shall be of double-box construction, the inner box of which shall be insulated from the outer box carrying the framework and running gear by having all nail heads, bolts, etc., countersunk to eliminate all possible contact to ground.

4. Whenever powder is not taken underground immediately upon delivery at the mouth of the mine from the outside storage magazine, it shall be placed in a well-constructed, locked, fireproof magazine which shall not be closer than 150 feet to the mouth of the mine or to any point at which a man trip loads or discharges. The powder shall remain in this magazine until loaded into the powder transportation car for delivery within the mine.

5. Powder shall be taken into the mine at the end of, or between, shifts and at a time when there are the fewest possible men at work within the mine. In no instance shall powder be taken into the mine when a regular shift of men, other than the third or eleven-o'clock (commonly called the "graveyard") shift is at work.

6. Powder shall be taken into the mine in the original unopened boxes as received from the manufacturer and handled by the railroad companies. Broken boxes, or boxes that have been opened, must not be handled in the regular manner as herein specified, but shall be handled separately, and by hand, from the outside storage magazine to the several units and working places.

7. In transporting powder within the mine on long, level hauls, same may be transported in approved standard powder car attached behind the locomotive.

8. When powder is being transported on motor runs, all other haulage on these entries or motor runs must be stopped and remain inactive from the time the powder transportation begins until it has reached its destination. The Mine Superintendent shall designate some responsible employe to supervise personally the movement of the powder car.

9. Powder shall be taken directly to centrally-located distribution stations within the mine, from which points it shall be distributed to the various units and working places. Only sufficient powder for one day's work shall be taken into the mine at any one time, and no powder shall be allowed to accumulate or remain in the underground distribution stations.

10. Underground distribution stations shall be made in the solid coal at least 300 feet from the main slope and 50 feet from any traveling way or intake airway, and shall be provided with a strong door that shall be kept securely locked except when entered by a person or persons so authorized. Distribution stations must be fire resisting, with end walls of tile or metal-lath-and-plaster construction.

11. Not over 200 pounds of explosives, including any surplus remaining from the previous day shall be placed in any one distribution station.

12. Once each shift all empty boxes, paper, sawdust, etc., must be gathered and sent from the mine. No accumulation of debris will be permitted in or around the distribution station.

13. Distribution by the powderman from the underground station to unit powder boxes shall be made in standard, electrically-nonconducting canvas bags similar to those sold by the powder manufacturers.

14. Unit powder boxes shall be of uniform size. Boxes shall be made with a dividing partition so that the fresh supply of explosives can be placed apart, thus permitting the use of the older stock first.

15. At each unit powder box there shall be a stamp, and as powder is delivered to the box by the powderman each stick must be stamped in such a manner as to be identified easily if found in other than its proper place. Stamps shall be inspected regularly to see that they leave a legible mark on each stick.

16. Each unit powder box shall be plainly marked on the outside showing the Unit number and the maximum number of sticks of powder that the box may contain.

17. Distribution stations underground shall be located and territory so allotted that a powderman will not

have more units to serve than can be visited once each shift with a powder delivery.

18. Except in emergencies, the powderman shall be an employe other than the employe assigned to the delivery of detonators.

19. In no case shall powder be made up at the working face. Powder shall be made up at the powder box and only the amount to be used taken to the face. If, for any reason, more powder is taken to the face than is required for the round of shots, the excess powder must be taken back to the storage box before the round of shots is fired.

20. Not more than 1½ pounds of powder shall be used in any one hole.

21. All detonators must be carried from the storage place outside the mine to the inside in standard leather containers which shall be painted yellow.

22. All detonators stored inside the mine shall be in a suitable receptacle, not closer than 50 feet to the powder storage boxes.

23. In no case shall loose detonators be taken to the working face.

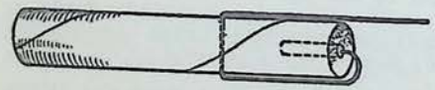


Fig. 26—Method of Using Detonator.

This approved practice is suggested by notes obtained from "Safety in the Handling and Use of Explosives," published by Institute of Makers of Explosives.

24. In the event that any detonators are lost, the Foreman in charge shall be notified immediately.

BLASTING PRECAUTIONS

(1) Permissible powder is **only** "permissible" when the proper amounts are used. Use only 1½ pounds of permissible explosives in any one hole.

(2) Never force a cartridge into a hole.

(3) To slit the cartridge and tamp tight is detrimental to the cushioning effect desired in blasting coal. This practice is prohibited.

(4) Wooden bars are provided for tamping holes. The use of iron tamping bars is prohibited.

(5) Use precautions in seeking the cause of a missed shot.

(6) To drill, bore or pick out a charge which has failed to explode, is prohibited. Either drill and charge another borehole at a safe distance (not less than two feet) from the missed hole, or, better still wash out the missed charge with water from the hose of your sprinkling line.

(7) Use only the proper containers as provided for in transporting or carrying blasting caps.

(8) Never try to withdraw the wires from an electric blasting cap.

(9) Always store electric blasting caps or blasting machines in a dry place.

(10) The leading wires attached to the blasting machine are to be disconnected and shunted immediately if it becomes necessary to return to the shot.

(11) When blasting is done electrically and a missed shot occurs, a five-minute interval should elapse before returning to the shot.

(12) Never return to any shot which has failed to explode without first disconnecting the shooting cable from the blasting machine, and short circuiting the wires of the shooting cable.

(13) Good wire connections are not secured when looped or tied. Scrape the ends of the wires clean and bright, and twist them tightly together.

(14) Always see that bared ends of electric detonator lead wires are twisted together or shunted and keep them so until just before firing, then untwist them and connect with firing lines.

(15) Leading wires are not to be dragged around. Always coil them and carry them.

(16) Suspend shooting cable on timber, being careful to see that cable is not in contact with signal lines, pan lines, power lines or track.

(17) Insert electric blasting cap in cartridge carefully. Have closed end of detonator pointing towards the bulk of the explosive. (See Fig. 26.)

(18) Storing or transporting electric blasting caps with any type of explosive is prohibited.

(19) Old or broken lead wires or connecting wires are not to be used.

(20) Blasting machines are to be kept clean and dry. They are built to operate with full force; twist the handles vigorously, not half-heartedly.

(21) Shooting from the trolley wire or feeder line is prohibited.

(22) Making up shots at the working face is prohibited.

(23) Excess powder or detonators are to be returned to their proper storage places before shooting.

(24) Be sure that you have proper shelter before shooting.

(25) Always warn men that are in close proximity of blasting areas. See that all approaches are safely guarded and the word "Fire" is shouted three (3) times before shooting.

(26) The shooting of dependent shots is prohibited.

MINE VENTILATION

Quantity.

Sec. 23-106, Wyo. Compiled Statutes.—"Ventilation—Gas and Fire Damp. The owner or operator of any underground coal mine shall provide and maintain for every such mine, ample means of ventilation affording not less than one hundred and fifty cubic feet of pure air per minute for each and every person employed in said mine, and as much more as the circumstances may require, which shall be circulated around the main heading and cross headings and working places to an extent that will dilute, carry off and render harmless the noxious or dangerous gases generated therein; the main current of air shall be so split or subdivided as to give a separate current of reasonably pure air to every fifty men at work, and the State Inspector of Coal Mines shall have authority to order separate currents for smaller groups of men, if, in his judgment special conditions make it necessary; and the air current for ventilating the stable shall not pass into the intake air current for ventilating the working parts of the mine. In mines generating fire damp, worked-out or abandoned parts thereof shall be kept free of standing gas, or properly walled off and the entrance thereto properly closed, and cautionary notice posted on the stopping to warn persons from danger, and every working place where gas is known or supposed to exist shall be carefully examined by the fire boss within two hours immediately before each shift, and all accessible abandoned places shall be examined twice a week with a flame safety lamp, and in making said examination it shall be the duty of the fire boss at each examination to leave at the face of every place examined, evidence of his presence in the form of his initial and date of his examination. The fire boss shall make a daily written report in a form approved by the State Inspector of Coal Mines. The report shall be made before the fire boss goes off duty for the day and this report shall be kept as a permanent record. And it shall not be lawful for any miner to enter any mine or part of mine generating fire damp until it has been examined by the fire boss aforesaid, and by him reported to be safe. Provided, however, that when special conditions warrant, the State Inspector of Coal Mines may designate a place or places in the mine, where the fire boss can meet the men and pass them to their respective working places. No room shall be driven more than fifty feet in advance of a breakthrough or airway; provided, however, that entries or development places may be driven three hundred (300) feet ahead of the last crosscut, but in that event proper brattice or other means must be used to carry the air to the work-

Air Splits.

Gas.

Inspection.

Report.

Distance Ahead of Air.

Entries.

ing face, the same to be approved by the State Inspector of Coal Mines. In any entry or passageway in which the ventilation is provided by a blower fan, said fan shall be located at least twenty-five (25) feet distant from the returning air, and said fan shall be so located that the returning air shall not re-enter the fan, and provided, that the outlet end of tubing used in connection with such blower fan shall not be more than twenty (20) feet from the working face. **ALL CROSSCUTS IN ROOMS AND ENTRIES, EXCEPT THE ONE NEAREST TO THE WORKING FACE, SHALL BE SEALED IN SUCH MANNER THAT THE AIR CURRENT SHALL BE DIRECTED ACROSS THE WORKING FACE.** In all mines the doors used in assisting or directing the ventilation of the mine shall be so hung and adjusted that they will close themselves, or be supplied with springs or pulleys so that they cannot be left standing open."

Blower Fans.

Crosscut Seals.

Where special blower fan ventilation is used in driving narrow work in non-gaseous mines, same may be driven 300 feet providing the approval of the State Mine Inspector is first obtained.

Quantity.

1. In no case shall the amount of air passing through the last break-through on any split be less than that set forth in the law.

Air Leakage.

2. The short circuiting or loss of air through leaks must not in any case exceed 35 per cent of the total air entering any split and, as stated, the amount set forth by law shall pass through the last break-through.

3. The quantity of air passed through any split shall be subject to the approval of the Supervisor of Ventilation.

Panel Ventilation.

4. Panels will be ventilated as shown in Fig. 27, wherever it is possible. In any event each panel shall be on its own split. Air shall not pass continuously over two or more panels.

Abandoned Places.

5. In panels or entries not working, that is, standing, the quantity of air passed shall be in accordance with the recommendation of the Supervisor of Ventilation.

6. Abandoned rooms (rooms standing in which the pillars have not been drawn), shall be walled off, confining the circulation of air to the entries and working places.

7. When abandoned workings are sealed off, stoppings shall be located as close to worked areas as possible.

Overcasts to Return.

8. When a mine is ventilated by having a main return on either side of the slope these main returns are to be connected by means of overcasts at necessary intervals. New mines will be opened with separate returns on each side of the slope.

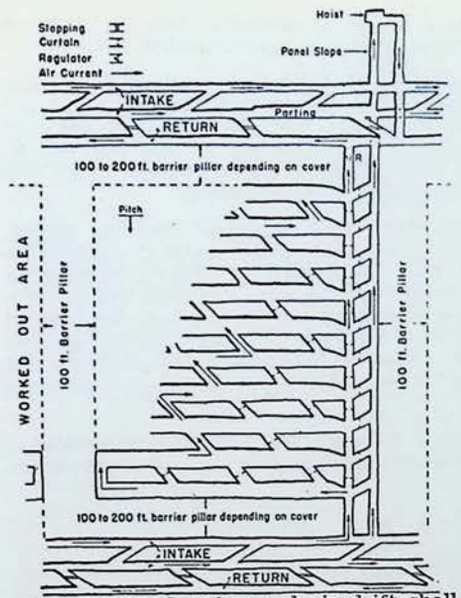


Fig. 27

Each panel must be on its own split and no air will be permitted to pass over two or more panels continuously.

Fireproofing.

9. The fan housing and air drift shall be of fireproof construction.

Fan Installation.

10. All fans shall be equipped with automatic starters, open phase relays, and pressure gauges. Motors shall be equipped with sliding base take-ups and endless belts. In no case is the distance between pulley centers to be less than three times the sum of the diameters of the two pulley wheels, except in cases where V-belts or similar types of special drive are used.

Motor Housing.

11. Motor house shall be of ample size to give clearance around machinery to permit oiling without stoppage of fan.

Belt Guards.

12. Belts shall be properly guarded by pipe-rails or other suitable means to prevent persons from coming in contact with them.

Permanent Stoppings.

13. Permanent stoppings between main intake and return shall be of concrete or tile construction and set into the rib 12 inches. Thickness of wall shall be 6 inches. Where mining is under excessive cover, and the crushing effect is such that the use of concrete or tile is impractical, wood blocks may be used in stopping construction in a manner approved by the General Manager.

Overcasts.

14. Overcast areas shall be in no case less than the area of the air course upon which the overcast is located.

15. Side walls and top of overcast shall be made of tile or concrete, the top to be re-enforced with steel.

No Doors In Overcasts.

16. No doors shall be placed in overcasts. Instead, inby of the entry upon which the overcast is placed, at the first cross-cut there shall be placed a trap door that may be used as an entrance to the air course (See Fig. 28). In entry stoppings a small door is to be placed every 500 feet to allow rock dusting in back entries.

Banking Of Overcasts.

17. The roof above each overcast shall be sloped, eliminating sharp breaks and corners and the end walls of the overcast shall be banked or graded, forming an approach or easement for the air. Drainage under overcasts shall be by pipes and not by ditches, the pipe to extend far enough back from the end wall so that the end banking will not cover it. Ends of pipe shall be left open and accessible for rodding in case the pipe becomes plugged.

Parallel Intakes.

18. In all mines having two parallel main intakes the crosscuts between these intakes shall not be blocked.

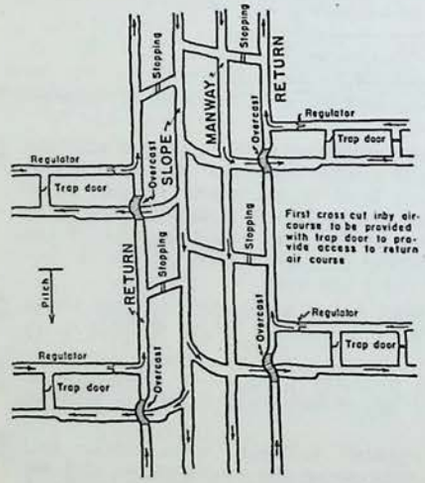


Fig. 28

Overcasts do not include doors. Instead inby of the entry the first crosscut will be equipped with trap door which can be used as an entrance to the air course.

Air Courses. Avoid Sharp Turns. Center Propped.

19. Air courses must be properly driven, and of uniform cross sectional area, avoiding sharp breaks and turns, the same to be thoroughly cleared before pulling the track, and where the roof has a tendency to cave or slough all back entries and main returns shall be center propped.

Caution As to Use of Doors.

20. In all mines the doors used in assisting or directing the ventilation of a mine shall be so hung and adjusted that they will close themselves, or be supplied with springs or pulleys, so that they cannot be left standing open. In addition to this, every door is to have a clearance of 8 inches from the floor so that loose coal or other material that might be on the floor will not hold a door open. The doors are to have sills to fill up these 8-inch spaces and on haulageways the bottom of door is to be of heavy canvas. The use of doors for the directing or diverting of air is prohibited within the mine where this can be accomplished by overcasts, etc.

Methane.

21. For the handling of explosive gas (CH4) see Safety Standards.

Examination of Mine Charts.

22. Fan charts must be changed daily before 7:30 a. m. and they shall be examined by the Mine Foreman, who will satisfy himself "that the fan has been in continuous operation for not less than six hours preceding his examination of the chart, before permission is given any working force to enter the mine." (See Sec. 23-110, Mining Laws of Wyoming.) Fan charts shall bear the date of their placement on recording instrument, and breaks in graph, whether showing complete stoppage of fan or changes in water gauge, must be explained in detail on back of charts. Explanations such as "power off," "repairing fan," "doors in main return open," etc., will not be accepted as explaining irregularities in water gauge.

The Mine Foreman will make prompt delivery of fan charts to Mine Superintendent, who will examine and thereafter countersign same, forwarding all charts to general office on the same day they are removed from the instrument.

Report Failure to Master Mechanic.

23. Failure of recording instrument to function properly must be reported to the Master Mechanic immediately. The Master Mechanic will immediately make necessary repairs or adjustments to put instrument in proper working order. All recording instruments shall be surrounded by lamp bank for heating in cold weather.

Notify Mine Foreman of Fan Stoppage.

24. Stopping of fans due to mechanical or electrical failures must be reported to the Master Mechanic or Chief Electrician immediately upon discovery. If such failure occurs during the working shift the Mine Foreman must be notified at once, also approximate length of time necessary to make repairs must be stated. Mine Foreman shall be notified when repairs are completed and fan is ready for operation.

When to Withdraw Men.

25. Whenever it shall be necessary for the mine fans at Hanna to be stopped for more than thirty minutes the men shall be withdrawn from the mine. In the Rock Springs district they shall be withdrawn in case the fan will be stopped for an hour or more.

NOTE: If it is deemed necessary by the Mine Foreman or Superintendent to withdraw the men before the expiration of the above time, they shall act upon their own judgment.

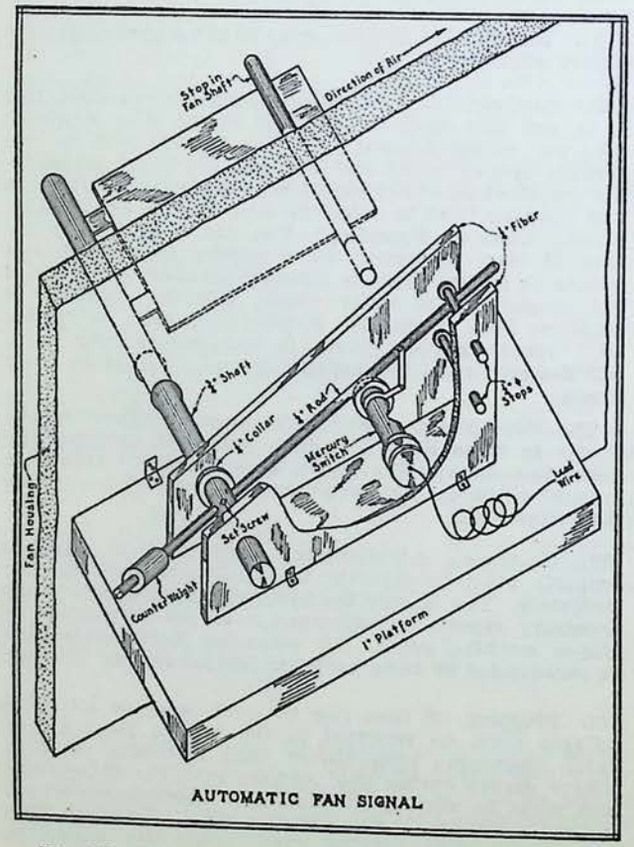


Fig. 29—Warning Device in case of Fan Stoppage.

Superintendent to Give Authority to Stop.

26. Fans must not be stopped by any person, for any cause, except for disability to fan or drive, or upon permission from the Mine Superintendent. (See "Surface Fires.")

Air Measurement.

27. Measurements of main intakes and returns, also intake and return of all splits, shall be made at the same point each time anemometer readings are taken. The area of the section where readings are taken is to be marked on rib or roof when possible. Check measurements by Supervisor of Ventilation will be made at these same points. All such readings shall be for a period of not less than one minute. When measuring air velocities the anemometer must be held so as to run forward and not backward.

Area Marked.

Automatic Fan Signal

28. Each fan shall be equipped with an automatic signalling device similar to that shown in Fig. 29, bell and light to be installed at any convenient point designated by the local Superintendent so that those responsible for fan operation will be immediately warned in case of fan shut-down.

Test of Automatic Fan Signal.

29. A test shall be made every six months by the Supervisor of Ventilation and the District Electrician of the automatic fan signal. One of these tests shall be made during the summer and one during the winter when approximately the maximum and minimum temperatures are occurring. In addition to making the tests of the mechanical parts of the device, they shall shut the fan down for at least ten minutes in order to assure themselves that the chimney effect of the fan shaft is not sufficient to render the device inoperative.

STANDARD SYSTEM FOR OVERCASTS AND METHOD OF CONSTRUCTION

1. Two general types of overcasts shall be used. Figures 30 and 31 show type and construction to be used where the roof conditions are good and where the walls and top will be subjected to but little vertical stress.

2. Figures 32 and 33 show type to be used under heavy cover and poor roof conditions and in which the end walls will be forced to carry considerable weight.

3. The place shall be properly timbered before excavation is made for overcast.

4. Temporary props as needed shall be placed under lip crossbars before shooting or loading out rock.

5. When the overcast has sufficient area, the roof shall be timbered and lagged. (Fig. 34.)

6. If entry haulage is continued during construction of overcast, temporary props mentioned in Par. 4 must be first removed and standard clearance maintained at all places. If clearance is not maintained, a flagman must be stationed at the overcast while mine is in operation.

7. If the entry is to be placed in operation before the overcast is completely shot down, all loose rock must be barred down and sufficient timber placed to prevent falling rock during such operation.

8. Whenever development plans show that an overcast will be necessary in the future working of a mine, the place should be driven far enough from the slope to make the necessary air course or manway connections and temporarily stopped until construction of the overcast is completed. Construction can be greatly facilitated if work can progress unimpeded by entry haulage.

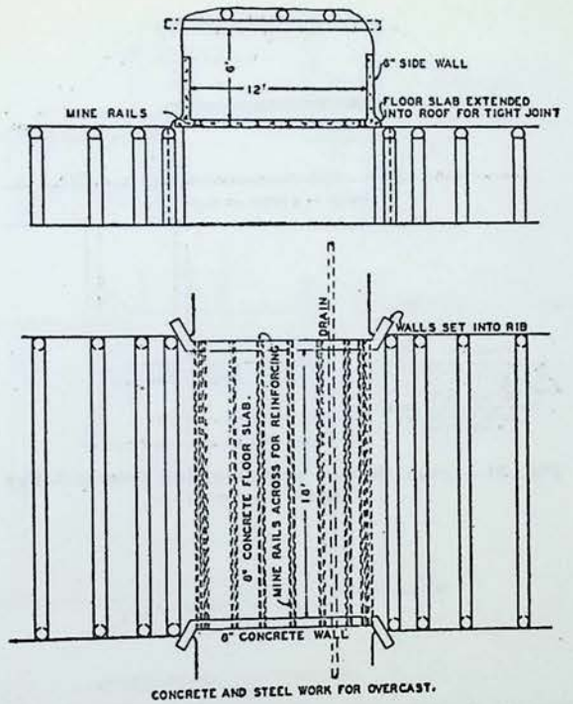


Fig. 30—Concrete Slab, Reinforced By Rails Across Entry, For Use Under Light Cover.

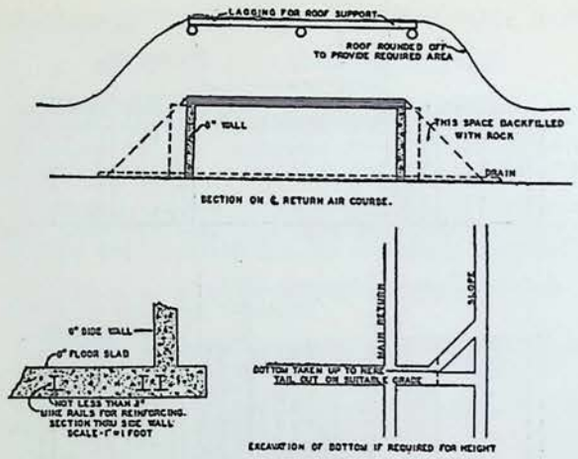


Fig. 31—Cross Section of Completed Overcast For Light Cover.

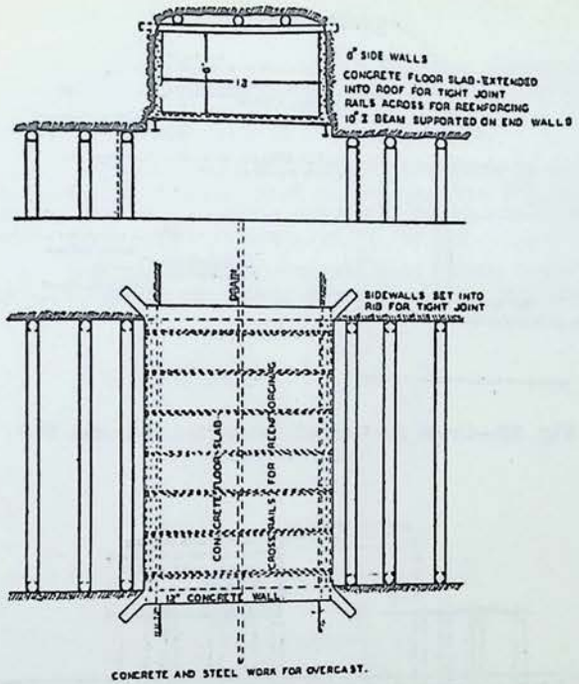


Fig. 32—Reinforced Concrete Slab Supported by I Beams. This Method To Be Used Under Heavy Cover Conditions.

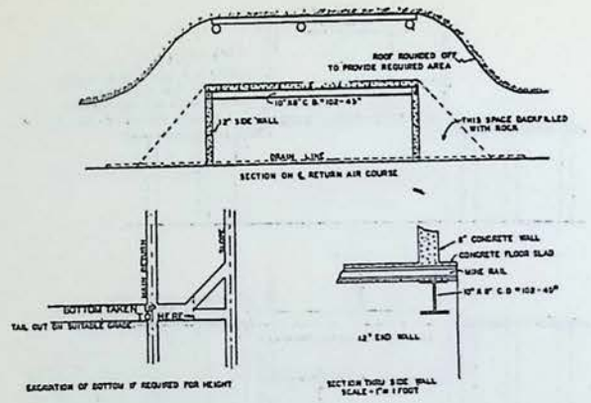


Fig. 33—Cross Section of Completed Overcast For Heavy Cover.

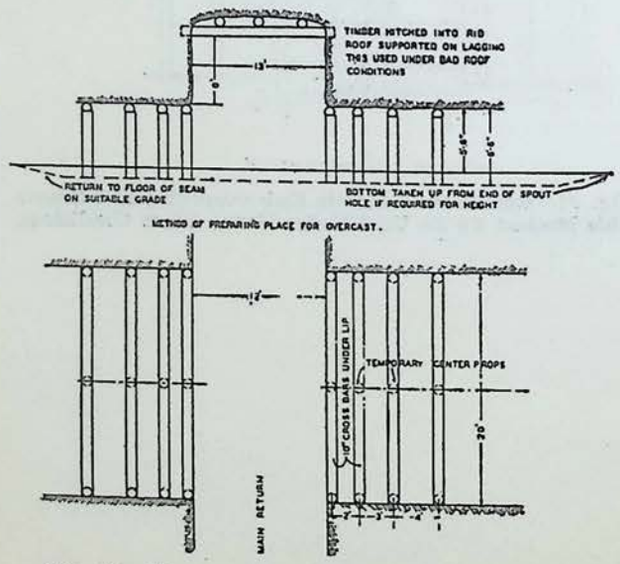


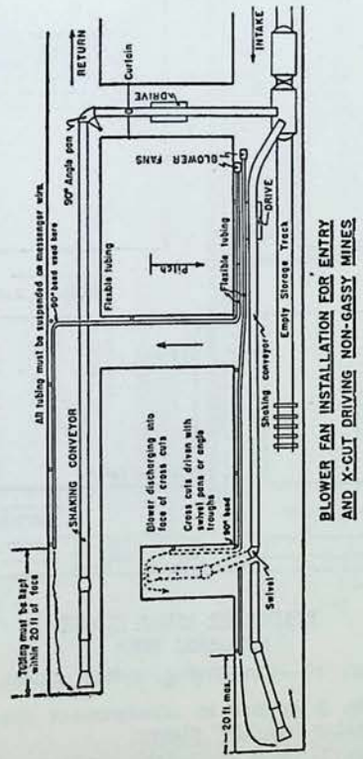
Fig. 34—Showing Method of Preparing Place For Overcast.

BLOWER FAN VENTILATION

1. Fig. 35 shows the method of installing blower fans for the ventilation of entries being driven in development. In no case must the blower be placed nearer than 25 feet to the last crosscut or break-through.

2. The volume of air passing on the entry in which the blower is installed must not be less than 2½ times the capacity of the blower. This will insure against the recirculation of air through the blower fan.

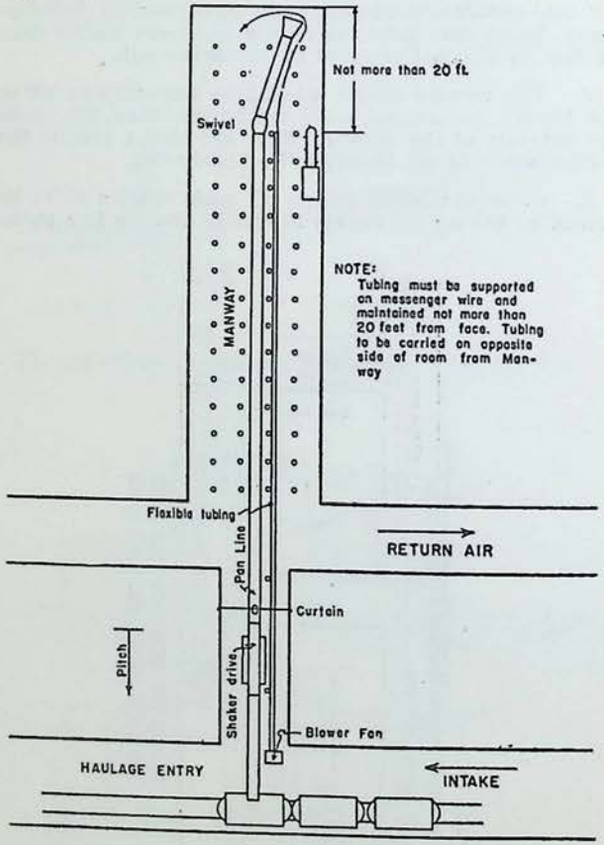
3. Crosscuts being driven off main entries must be driven by having the blower discharge directly into them.



BLOWER FAN INSTALLATION FOR ENTRY AND X-CUT DRIVING NON-GASSY MINES

Fig. 35—Installation of Blower Fans.

4. The volume of air passing on the entry upon which the blowers are located must not be less than three times the sum of the capacities of all blowers located upon that entry.

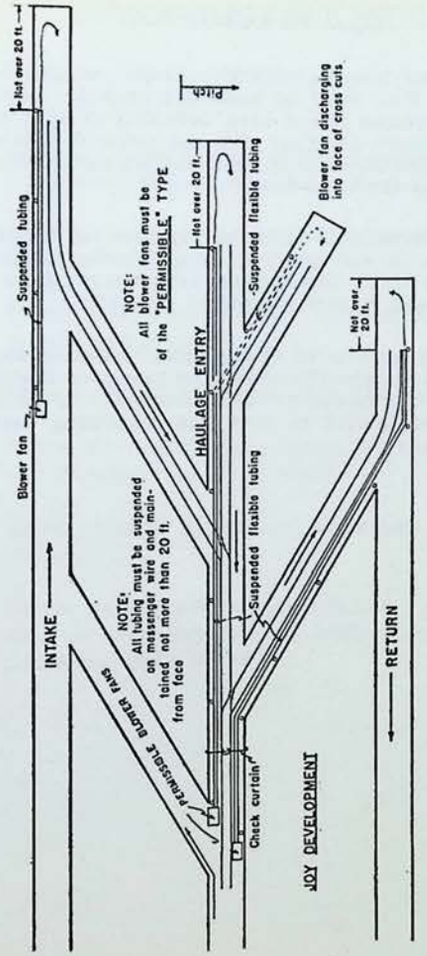


VENTILATING UPHILL PLACES
NON-GASSY MINES

Fig. 36—Ventilating uphill places.

5. Rule No. 2 applies to arrangement shown in Fig. 36 for ventilating "up-hill" places.

Note: Rules 1 to 5, inclusive, apply to non-gaseous mines only.



BLOWER FAN INSTALLATION
3 ENTRY SYSTEM
HANNA MINES

Fig. 37

6. Fig. 37 shows arrangement for 3-entry development at Hanna, or other gassy mines. All blower fans shall be of the "permissible" type.

IDLE MACHINERY

Machinery to Be Kept Serviceable.

1. Idle machinery, such as pumps, motors, hoists, locomotives, etc., shall be kept in serviceable condition at all times unless it has been definitely decided by the General Manager, together with the General Master Mechanic or Chief Electrician, that certain equipment is to be withdrawn from service.

Return Borrowed Parts.

2. It is permissible to take parts from any idle equipment in case of emergency to repair similar equipment, but just as soon as this is done, replacement parts shall be ordered and repairs completed promptly.

Repairs and Replacements of Idle Machinery.

3. Machinery located at any mine (inside or outside) which is idle temporarily should be gone over thoroughly and proper repairs and replacements made to make and keep such equipment in first class operating condition at all times.

USE OF LIFTING JACKS

1. Examine jack carefully for defects. Do not use a defective jack.
2. Use only regular jack handle. The use of machine bars, pieces of pipe, etc., is forbidden.
3. See that foot of jack is firmly placed and secured against slipping.
4. Place small block of wood between lifting surface of jack and machine.
5. Have sufficient blocking and crib material on hand.
6. Follow the machine up or down with crib and blocks as it is being raised or lowered.
7. Always remove jack handle when jack is not being operated.
8. Do not go into narrow space between machine and walls or other objects until cribbing has been completed and jacks removed.

MOVING SHAKER CONVEYOR

1. When a shaking conveyor is to be moved, the Unit Foreman will examine the new location and ascertain that the place has been properly prepared.
2. The Unit Foreman will see that proper tools and equipment are available.
3. The Unit Foreman will designate a lead man for the moving crew who has been trained in the moving of shaker units.
4. The Unit Foreman will instruct the lead man as to exact methods of completing the work.
5. The lead man will check all tools and equipment, reporting any shortages or defects to the Unit Foreman.
6. The lead man will check all hitches and fastenings before any strain is put upon them.
7. Where lifting jacks are used, the general rules (Page 101) covering the use of lifting jacks must be followed.
8. When any piece of shaker equipment is being moved by locomotive, cutting machine, or other application of power, no one will be permitted to get in a position where he can be struck if the piece being moved catches or skids. Men must remain in the rear or front of the equipment until movement is stopped.
9. Where equipment is being moved on pitching bottom, caution must be used to see that it cannot slide downhill out of control.
10. The following methods for controlling moving equipment in pitching places are approved:
    (a) Holding back with rope of mining machine.
    (b) Use hemp snubbing rope with secure snub around well-set prop.
    (c) Holding by means of standard prop puller or pull lift.
11. Where shaker engines are being moved by dragging with a rope-equipped cutting machine, one rope from the machine must be fastened to the high side of the engine and kept taut so as to prevent the engine from sliding downhill. The other cutting machine rope must be secured to a jack pipe so that the cutting machine is firmly anchored.

    These fastenings must not be removed until the engine has been cribbed and aligned and the jacks removed.

    Where the use of a cutting machine is not practical, a prop puller or pull lift may be used in a similar manner.
12. The Unit Foreman will check on the progress of the operation as often as his duties will permit.

SYSTEMATIC TIMBERING

Standard method of timbering and recovery of props, driving of rooms and entries, and the successive steps in pulling pillars in rooms and entries, is shown in Fig. 38.

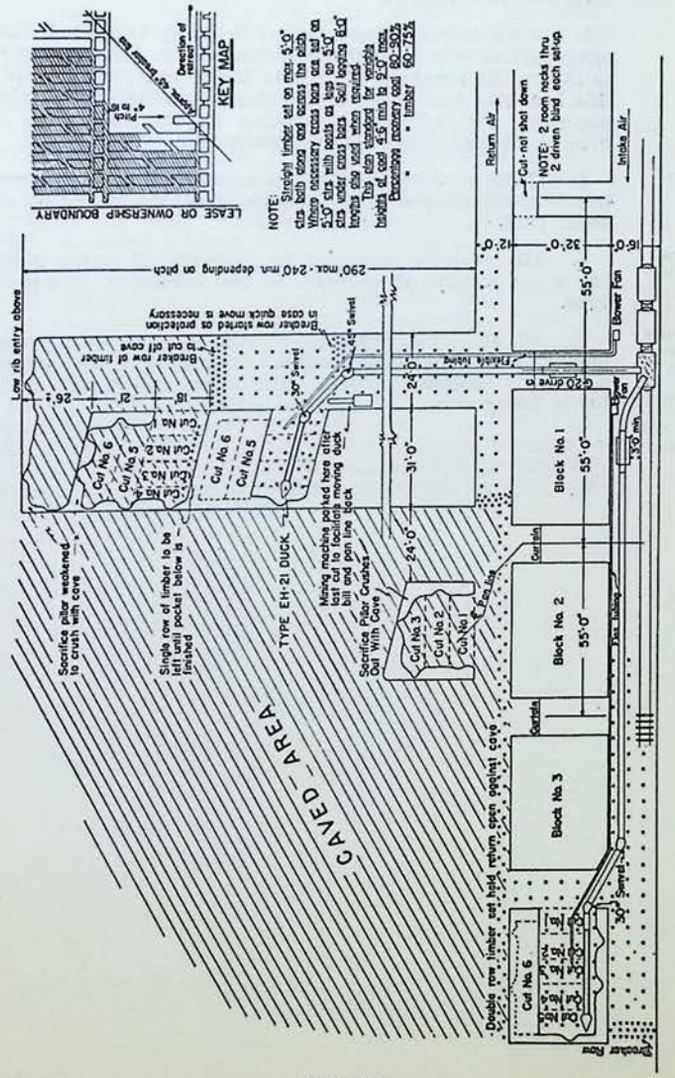


Fig. 38

RECOVERING TIMBERS

Distance Between Props.

1. When driving rooms and straight props are to be used, the props are to be set at no greater distance apart than five-foot centers.

Breaker Rows.

2. In all mines, where timber is being recovered, the prop pullers will set enough timbers as a breaking row to insure the breaking off of any fall of cap rock or roof, this breaking row to be set so that at no time will it be necessary for the men recovering the timbers to go a greater distance than 25 feet from the breaking line.

Props at Pillar Pockets.

3. Three rows, or more if necessary, of props on not less than one-foot centers shall be set at upper end of all pillar pockets.

Mechanical Prop-Pullers.

4. All employes engaged in recovery of props must use a mechanical prop-puller of the Sylvester, or equal, type.

Two Years Experience Required.

5. All employes engaged in recovery of props must have at least two years practical mining experience under conditions comparable with those under which prop pulling is being done.

SURFACE FIRES

Stopping Fan For Surface Fires.

1. In the event that any structures such as tipples or other inflammable buildings in the vicinity of the mine mouth catch fire, the mine ventilating fan should be stopped in order that the smoke may not be drawn into the mine and circulated around the mine workings, causing injury or death to employes. All men should then be withdrawn from the mine without delay.

Fire Doors.

2. Unless existing structures located within 100 feet of any mine opening are of reasonably fire-proof construction, fire doors shall be erected at effective points in mine openings to prevent smoke or fire from outside sources endangering men working underground. These doors shall be tested at least monthly to insure effective operation.

Remote Fans.

3. Where fans are remote from the mine entrance, and are electrically driven, they should be stopped by pulling the power switch, whether the switch be at the main power plant or at some distributing station.

Authority Delegated to Responsible Persons.

4. Certain responsible persons, delegated by the Mine Superintendent, should be instructed to do this under the above condition. Where mine fans are in close, or reasonably close, proximity to the main intake then, likewise, similarly responsible persons should be designated by the Mine Superintendent to stop the fans.

RAILROAD CAR RETARDER SAFETY RAILS

Car Retarder Safety Rails.

1. At each tipple having a Fairmont Standard Type Railroad Car Retarder, there shall be installed safety rails which shall conform in plan to Fig. 39. Rails "B" are to be set in concrete 2 to 4 feet below surface, depending on character of soil, rail "A" to be set 2 feet in soil.

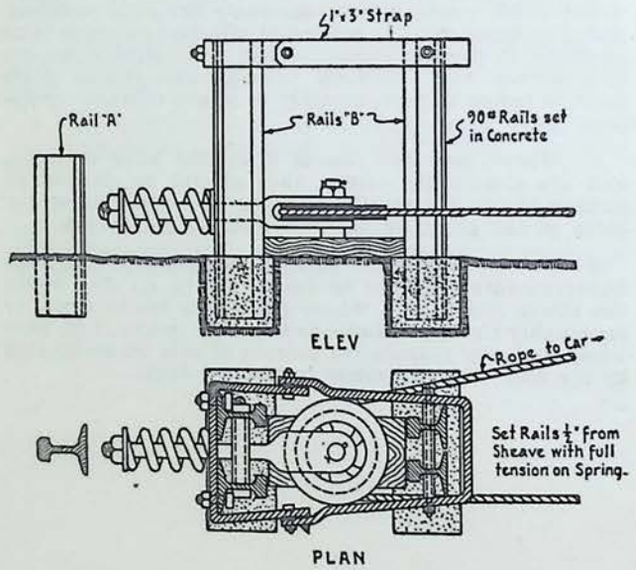


Fig. 39—Railroad Car Retarder Safety Rails.

CONCRETE

Concrete is particularly well adapted to use in mines since it has a remarkably high resistance to deterioration under the severest conditions of mine use. It is one of the most economical in cost of all permanent building materials, and much of the new construction as well as replacement and repair work around a coal mine can be done by mine forces.

Cement Storage.

Certain fundamental requirements for the selection and care of materials should be observed to produce the most durable job. Cement should be stored in dry places or under waterproof coverings to protect it from hardening due to dampness. Storage in the mine may result in some loss of strength especially if the mine is damp. Sand should be clean and free from particles of shale, fire clay, or coal dust. For the coarse aggregate in concrete it is desirable to use only clean, tough, crushed natural stone or gravel. Many of the natural rocks in and around a coal mine are not suitable for the making of a good grade of concrete. This refers especially to slates, shales, fire clay and soft sandstones. These materials tend to disintegrate at the surface of the concrete, thus paving the way to progressive damage.

Mixing Concrete.

Mechanical mixing should be used whenever possible, mixing to continue for not less than 1¼ minutes. Hand mixing is often necessary in a mine. Hand mixing should be done on a tight platform and the most uniform mixing will be obtained if the fine aggregate is first spread out on the platform, followed by the cement and coarse aggregate, and the whole mass turned over three or four times before water is added, a little at a time, in a crater in the center of the mix. Hand mixing should continue until the mass is of uniform color throughout and all stones are well coated with mortar. Too much water should never be used. Not only does too much water weaken the concrete, but it makes it porous and of low resistance to weathering and results in a mixture that cannot be placed without segregation.

Forms and Reinforcement.

Forms should be water-tight and well braced. The pressure of wet concrete which a form must sustain varies with the depth and rate of placement. Reinforcement should be so placed that it will be covered by at least 1 inch of concrete in roof slabs or walls and 2 inches in beams and columns. Where water is encountered, all steel should be covered by at least 2½ inches of sound concrete to prevent corrosion, which will cause the concrete to spoil or split.

When concrete is placed to any considerable depth, spading combined with excess of water will usually cause fine materials, dirt and scum, to rise to the surface. This solidifies in a soapy layer and is called laitance. It has very little if any strength and should be scraped off as soon as the concrete has stiffened. If left in place it will disintegrate and leave a weak spot in the structure.

Avoid Freezing.

When placing concrete in winter there is danger that freshly placed concrete will freeze. Alternate freezing and thawing will completely destroy the concrete, while a single freezing may impair the strength and durability of the job. Because of these facts special precautions are required for cold weather work. There is little likelihood that concrete will ever be subjected to freezing temperatures underground. Heating aggregates and mixing water and enclosing the work, together with provisions for artificial heat over a period of five or six days, is the usual method of protecting concrete.

Mixture to Use.

In fixing the proportions of the mix, varying types of work will require varying proportions. The average for ordinary work will be 1 part of cement, 2½ parts of sand and 4 parts of coarse aggregate, using the minimum of water to give a workable mass. Care should be taken when using a shovel as a measuring unit that the shovel is heaped the same for each shovelful.

Use of Quick Setting Cement.

Where quick setting is essential, about four sacks of "Lumnite" or similar quick-setting cement should be kept in stock for emergency use.

Consult Engineering Department on Special Work.

On all special work, such as beams, walls, water-tight structures and reinforced work the Engineering Department should be consulted before the work is undertaken.

PUMPS

Location.

1. The pump should be located in an accessible position as close to its source of supply as possible, and should be placed below the water level in the sump so that water may flow into the pump by gravity, particularly in the case of a centrifugal pump. Wherever possible, a sump arrangement as shown in Fig. 40 and Fig. 41 should be used. Suction pipe should be about 12 inches above the floor of sump and should pass through the concrete wall or dam in a suitably packed joint, and in no case should it be grouted solidly. A suitable drain shall be installed and placed so that its inlet will be directly below the strainer in the sump. Sudden opening of the valve on this drain would tend to dislodge any sediment which had collected around the strainer.

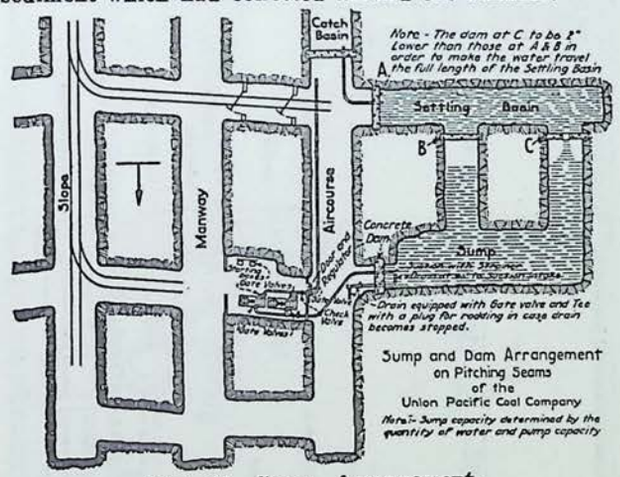


Fig. 40—Sump Arrangement.

Setting.

2. The pump foundation shall be substantial enough to support the pump rigidly and shall extend high enough above the floor line to provide for the draining of leakage from plungers or stuffing boxes and so that the entire pump may be kept clean.

3. All piping must be so supported that the pump castings are relieved of all strain.

Suction Piping and Connections.

4. The piping shall be at least the size of the pump opening, and in case of long lifts shall be at least one size larger. In case the suction piping receives its water

under pressure, a gate valve shall be installed to allow removal of the pump for repairs. The piping shall be as short and direct as possible and any turns should be made with long radius bends. A suitable strainer must be provided. A check valve may be placed on pump suctions having a long lift but should not be installed unless absolutely necessary, as there is danger of splitting pump casting if the valve closes before the one on the discharge, in case of sudden pump stoppage.

PIPE SIZES FOR VARIOUS CAPACITIES

DISCHARGE GALLONS PER MINUTE	SUCTION "B" DIA. INCHES	DISCHARGE "A" DIA. INCHES
100	7	5
200	8	6
300	9	7
400	9	7
500	10	8
600	11	9
700	11	9
800	12	10
900	12	10
1000	12	10

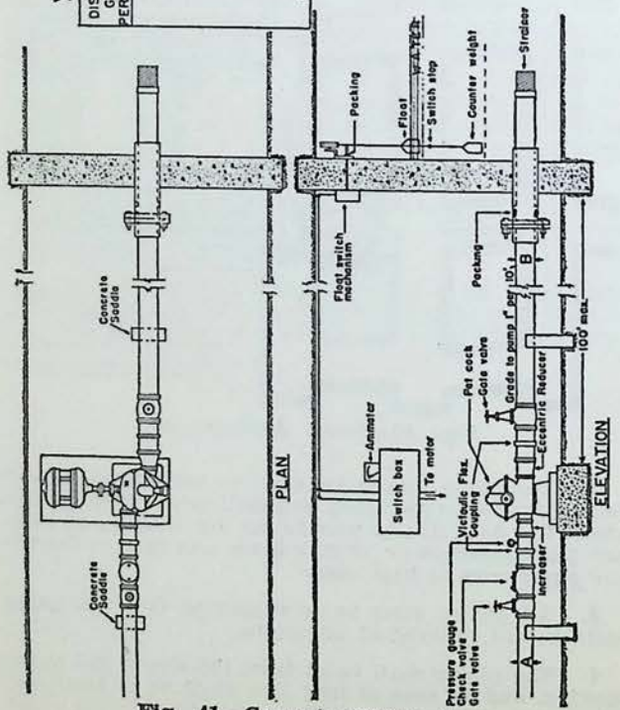


Fig. 41—Concrete Water Dam.

5. This piping shall be at least the size of opening in the pump for short lines, and in the case of long lines must be enough larger to greatly reduce the friction losses. **Discharge Piping.**

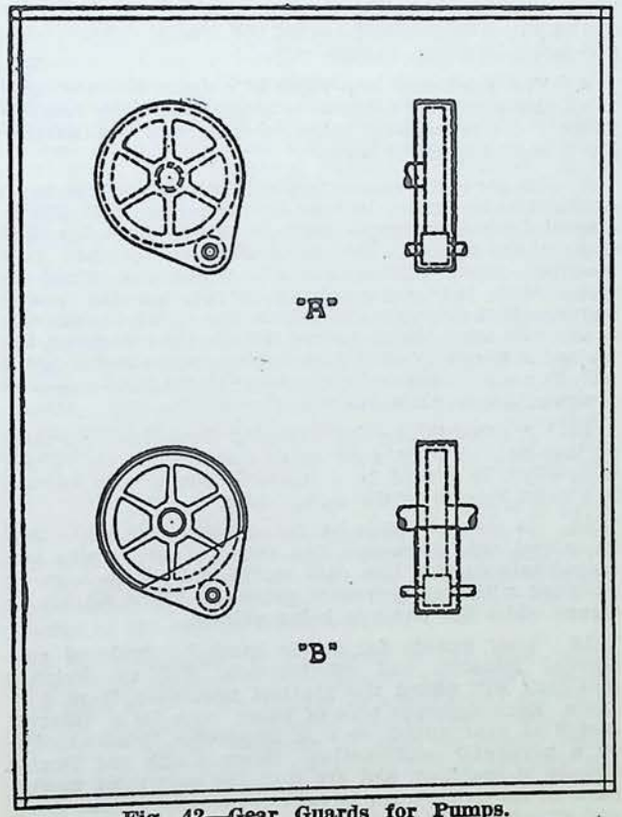


Fig. 42—Gear Guards for Pumps.

6. In the installation of a plunger pump, no gate or globe valve shall be used without the use of a relief valve between the gate or globe valve and the pump. A check valve shall be placed in the discharge line to protect the pump from water hammer when the power is suddenly cut off. **Valve Location.**

Check and Gate Valve on Discharge from Centrifugals.

7. In the installation of a centrifugal pump, a check valve and a gate valve shall be used, the check valve to be between the gate valve and the pump to allow inspection of the check valve in case of leakage. The gate valve shall be used for throttling in case pump duty is somewhat under its rated head, and also in starting up or shutting down the pump to avoid stresses thrown on the pump by suddenly having full load thrown upon it and water hammer, respectively.

8. The discharge line shall be tapped between gate valve and pump for a pressure gauge, and static and dynamic pressure readings taken on the larger installations and a record made of same.

Special Pressure Gauge.

9. To prevent damage to the internal wearing parts of centrifugal pumps, in case they suddenly lose water, a special pressure gauge shall be mounted on the first stage of the casings. This gauge shall be equipped with electrical circuit-closing contacts which are wired in series with the under-voltage release on the motor starter. If the pressure is lost in the pump casing, the gauge will close the electrical circuit, thus stopping the motor. A normally open push button on the motor panel will be used to short circuit the contacts in the special pressure gauge while starting the motor.

Drainage Lines.

10. A suitable line for draining discharge line shall be installed between gate valve and the pump. These lines shall be placed in a common header and carried to a point outside of the pump room.

Priming Lines.

11. In case of pumps having a suction lift a line may be tapped onto discharge line ahead of gate valve and tapped into suction line. All centrifugal pumps must be provided with the necessary valves to allow all air to escape while the pump is being primed.

Gear Guards for Pumps.

12. Gear guards for pumps must be made of substantial material and construction, and so designed that they will afford the greatest protection from accidents. Each different type of pump calls for a different design of gear guard, so it is impossible to standardize on a particular construction. Gears which are located outside of bearings, and are thus the outermost moving parts of the pump, must be fully covered as to rim, mesh, and exposed side, as shown by "A," Fig. 42. Gears located on shaft inside of outboard bearing are usually dangerous only from contact with the rim, which should be covered with a band somewhat wider than the gear face and plates should cover the point at which gears mesh as shown by "B," Fig. 42. In case of large gears, full side covers should be used if possible. Guards of this type will afford protection to operator and inspector

and the pump must be stopped for greasing and all adjustments, even though of minor character.

13. Pumps used in temporary settings, as in slope sinking, should be fitted with guards before installation and should be so set that a fence may be maintained for the protection of persons in passing.

Deep Well Pumps.

14. Deep-well pumps of the reciprocating type, consisting of a geared or belt-driven driving head on the surface actuating a vertical sucker rod, present about the same problems for lubrication and guarding as the plunger pumps which are covered in a previous paragraph. The centrifugal type, with its rapidly rotating vertical shaft which has numerous bearings to prevent shaft whip, must be given particular attention, as an accident to the shaft or parts below the surface may require dismantling of the entire shaft and casing. The shaft is protected from contact with the liquid pumped by a cover pipe, the couplings of this pipe also constituting the bearings for the shaft. Oil is introduced at the top bearing and lubricates all bearings as it travels downward on the shaft. This oil feed, best accomplished by use of a wick-siphon type of oiler, must be started sufficiently in advance of starting the pump to allow oil to reach all bearings on the shaft before the pump is started. The weight of the shafting and rotating parts of the pump is carried on a ball bearing, or a Kingsbury type thrust bearing, and, in the case of a large pump, water cooling of the oil in this bearing is necessary, and provision should be made for a sufficient discharge head to supply this cooling water if no other supply is available. Permanent marks on the pump casting or measurements taken will provide means for checking wear on the thrust bearing so that the clearance of pump parts below the surface may be maintained to prevent damage at the bottom of the well.

In the installation of equipment of this kind, where the quantity of water to be pumped is not known, knowledge must be obtained usually by a temporary air lift so that the proper size equipment may be purchased, or, in the case of air-lift pumping, so that the proper depth of hole may be drilled to attain the proper submergence for efficient pumping.

Each deep well should have a suitable steel headframe or tower to facilitate repair of broken parts or leaky pipes.

SHAKING CONVEYOR INSTALLATIONS

1. Fig. 43 shows the arrangement of entry crosscuts for shaking conveyors, and Figure 44 shows standard installation of loading head ends for shaking conveyors.

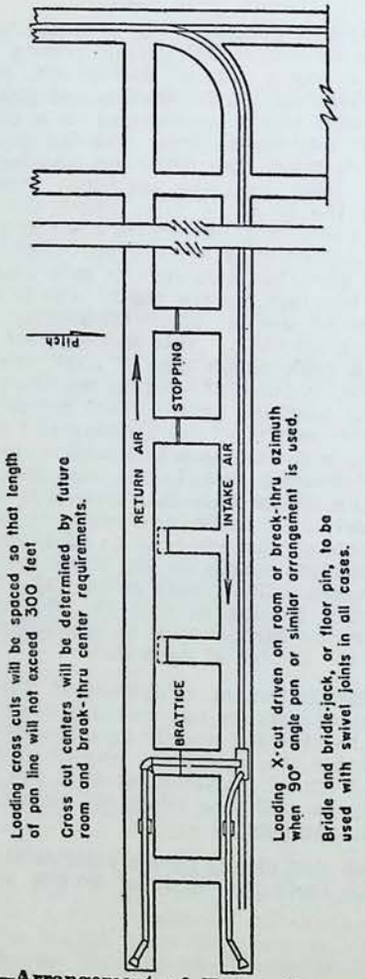


Fig. 43—Arrangement of Entry Crosscuts for Shaking Conveyors.

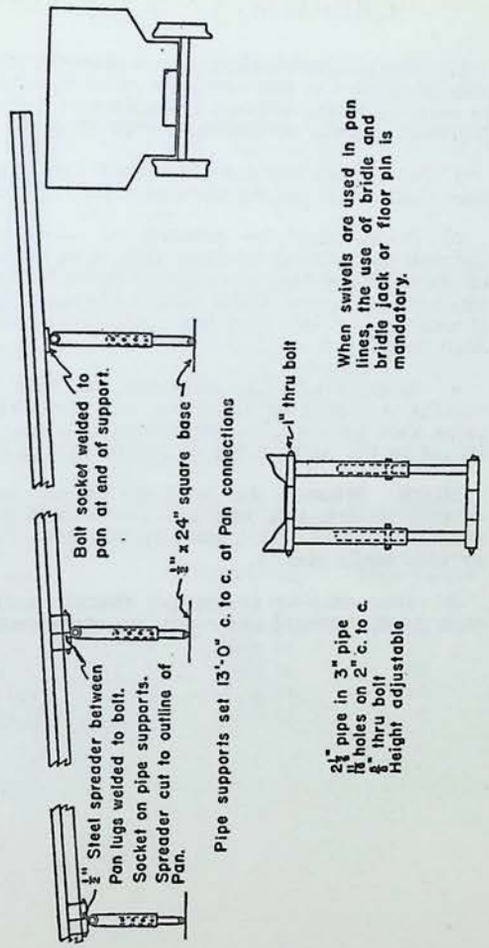


Fig. 44—Standard Installation of Loading Head End for Shaking Conveyor Using Pipe Supports.

GREASING OF WIRE ROPE

Oil Penetration.

1. The proper oil should be a preservative which not only penetrates to the hemp center of the rope (in order to saturate it and prevent absorption of water) but also thoroughly coats the inside of each strand.

Greasing.

2. The main haulage rope shall be greased at least once each week, and panel slope ropes twice each month.

3. Ropes shall be greased by passing the ropes through "V" shaped troughs, this to be done at the end of the shift and the rope allowed to lie in the slope over night off the drum. Those portions that cannot be passed through the grease box, but must remain on the drum, shall be painted.

Annealing and Resetting.

4. Sockets must be annealed and reset every four months, a record of annealing and resetting of sockets to be kept by the Mine Superintendent, the record to be signed by the party doing, or having charge of, the work.

NOTE: Where it has been the practice to make rope sockets locally, this will be discontinued as it is possible to purchase equipment of this kind fully as good as that made locally.

5. One complete socket and shackle shall be kept at each mine, annealed and ready for replacement.

WIRE ROPE

Precautions to be Observed When Cutting Rope.

Important Precaution.—In the manufacture of wire rope, great care is exercised to twist the wire in the strands and the strands in the rope under uniform tension. If the ends of wire rope are not properly secured the original relation of tension, as manufactured, will be disturbed and maximum service will not be obtained due to the fact that some strands are carrying the greater portion of the load.

When cutting steel wire rope it is very essential to place three sets of seizings each side of the cut to prevent disturbing the uniformity of the rope. The placing of proper seizing requires considerable practice and it is therefore advocated that the average user of wire rope exercise great care when placing seizings and for safety use a greater number of seizings than specified.

Unless a serving mallet is used, there is no advantage in making more than 10 wraps of wire per seizing.

Annealed Iron Wire of the following sizes should be used for seizing:

Diam. Rope	Wire Diam.	Birmingham Wire Gauge
3/8 x 1/2 in.	.047 in.	18
5/8 in.	.054 in.	17
3/4 in.	.063 in.	16
7/8 and 1 1/8 in.	.080 in.	14
1 1/8 and 1 7/8 in.	.105 in.	12
2 in. and larger	.135 in.	9

ROPE INSPECTOR'S REPORT

Mine.....Location.....

Date.....Date of Last Inspection.....

Diameter of Rope.....Length.....

Gross weight of trip hauled.....tons. Slope angle.....

Manufacturer of rope.....

Kind of rope, lay, strand, steel, etc.:.....

.....

Condition of Socket.....

Date Socket was last annealed.....

.....

Condition of rope:.....

.....

Date rope was installed.....

Probable remaining life of rope.....

Has rope proven satisfactory to date?.....

If not, how and why has it failed:.....

.....

Date last greased.....

Date rope was turned.....

Date removed.....

Total life of rope.....

Tons hoisted.....

Cost of rope.....

Cost of rope per ton carried.....

.....

.....

.....

.....

.....

.....

Signed: .....

Inspector.

NOTE: This report shall be made monthly, in triplicate, one copy to be forwarded to general office, one to local superintendent, and one filed with the Master Mechanic having charge of the inspection.

PROPER SOCKETING OF WIRE ROPE TO DEVELOP ITS FULL STRENGTH

1. Measure from end of rope a length equal to basket of socket. Serve at this point with not less than three seizings. Cut out hemp center. Open strands.

2. Separate wires in strands, straighten by means of an iron pipe. Cleanse with kerosene oil. Wipe dry.

3. Dip wire into ½ muriatic acid ½ water (use no stronger solution). Keep wires in long enough to be thoroughly cleansed. Wipe dry. Serve ends temporarily so that socket may slip over all wires. Be sure to cut this temporary serving as soon as the rope has entered the base of the socket.

4. Have all wires evenly distributed and even with the top of the basket. Place fireclay around base of socket.

5. Pour in molten zinc. Do not use lead, babbit, or other antifriction or low-melting alloy.

6. Allow to cool before using. It is not necessary to remove the seizings, though all except the one at the base of the socket may be removed if desired.

WIRE ROPE

Dimensions and Strength 6 Strands, Hemp Core

Diameter, Inches	Approximate Circumference, Inches	Weight, Per Foot, Pounds	Crucible Steel		Plow Steel		Minimum Size of Sheave, Feet
			Breaking Strength, Tons	Safe Working Load, Tons	Breaking Strength, Tons	Safe Working Load, Tons	
7 Wires per Strand							
3/32	7/8	.125	2.5	.5	3.4	.68	1.75
1/8	1	.15	3.5	.7	4.4	.88	2.25
3/8	1 1/8	.22	4.6	.9	5.9	1.20	2.75
7/16	1 1/4	.30	5.5	1.1	7	1.40	3
1/2	1 1/2	.39	7.7	1.5	10	2	3.50
9/16	1 3/4	.50	10	2	12	2.40	4
5/8	2	.62	13	2.6	16	3.20	4.50
11/16	2 1/8	.75	15.4	3.1	18	3.60	4.75
3/4	2 1/4	.89	18.6	3.7	23	4.60	5
7/8	2 3/4	1.20	24	4.8	31	6.20	6
1	3	1.58	31	6.2	38	7.60	7
1 1/8	3 1/2	2	37	7.4	47	9.40	8
1 1/4	4	2.45	46	9.2	60	12	9
1 3/8	4 1/4	3	53	10.6	72	14.40	10
1 1/2	4 3/4	3.55	63	12.6	82	16.40	11
19 Wires per Strand							
1/4	3/4	.10	2.20	.44	2.65	.53	1
1/8	1	.15	3.10	.62	3.80	.76	1.25
3/8	1 1/8	.22	4.80	.96	5.75	1.15	1.50
7/16	1 1/4	.30	6.50	1.30	8	1.60	1.75
1/2	1 1/2	.39	8.40	1.68	10	2	2
9/16	1 3/4	.50	10	2	12.30	2.40	2.25
5/8	2	.62	12.50	2.50	15.50	3.10	2.50
3/4	2 1/4	.89	17.50	3.50	23	4.60	3
7/8	2 3/4	1.20	23	4.60	29	5.80	3.50
1	3	1.58	30	6	38	7.60	4
1 1/8	3 1/2	2	38	7.60	47	9.40	4.50
1 1/4	4	2.45	47	9.40	58	12	5
1 3/8	4 1/4	3	56	11.20	72	14	5.50
1 1/2	4 3/4	3.55	64	12.80	82	16	6
1 5/8	5	4.15	72	14.40	94	19	6.50
1 3/4	5 1/2	4.85	85	17	112	22	7
1 7/8	5 3/4	5.55	96	19	127	25	8
2	6 1/4	6.30	106	21.20	140	28	8
2 1/4	7 1/8	8	133	26.60	186	37	9
2 1/2	7 7/8	9.85	170	34	229	46	10
2 3/4	8 5/8	11.95	211	42.20	275	55	11

INCLINED PLANES

Where wire ropes are used for moving loads on slopes and inclined planes, the stresses to which the ropes are subjected is a function of the inclination of the plane.

In the table below are given the stresses per ton of load for planes of different degrees of inclination. An allowance is made for rolling friction, but the weight of the rope is not taken into account. In long hauls, however, the latter is a factor of importance and must be allowed for.

In using the table a factor of safety of from five to seven should be employed. That is, the working stresses on the rope should not exceed one-fifth to one-seventh of the breaking stress. For very steep planes, a safety factor of five may be used; but for gentle inclines, where the rope drags heavily, a factor of six or seven should be used.

Elevation in 100 Feet	Corresponding Angle of Inclination	Stresses in Lbs. on Rope per Ton of 2,000 Lbs. Load
5	2° 52′	112
10	5° 43′	211
15	8° 32′	308
20	11° 19′	404
25	14° 02′	497
30	16° 42′	586
35	19° 17′	673
40	21° 48′	754
45	24° 14′	832
50	26° 34′	905

Example: How many cars can be safely handled on a 14° 02′ pitch with a six-strand, 19-wire, plow-steel rope, 1¼ inches diameter, assuming weight of empty car to be 4,500 pounds and holding 7,400 pounds of coal?

Solution: Wt. of car..... 4,500 lbs.
Wt. of coal..... 7,400 lbs.

11,900 lbs. or 5.95 tons.

From above formula
stresses on rope
on 14° 02′ pitch $497 \times 5.95 = 2{,}957$ lbs.
or 1.5 tons.

Safe working load
1¼ plow steel
rope (Page 120) 12 tons ÷ 1.5 = 8 cars

Example: What size plow-steel rope, six-strand, 19-wire, must be used on a 14° 02′ pitch to safely handle ten cars, assuming weight of car to be 4,500 lbs. and the weight of coal to be 7,400 lbs.?

Solution: Wt. of car..... 4,500 lbs.
Wt. of coal..... 7,400 lbs.

11,900 lbs. or 5.95 tons.

From above formula
stresses on rope
on 14° 02′ pitch $497 \times 5.95 = 2{,}957$ lbs.
or 1.5 tons.

For ten cars 10×1.5 tons $= 15$ tons.

From table, page 120, safe working load for 1⅜ in. rope is 14 tons and for a 1½ in. rope 16 tons. Therefore a 1½ in. rope must be used.

DRAWBAR, BRAKE AND HITCHING INSPECTION

Examination.

1. Mine car inspectors shall carry hammers and give the drawbars a thorough physical inspection by tapping or other means.

Mark Defect.

2. Defective cars shall be marked, plainly setting forth the defect.

Marking O. K.

3. All cars found in good condition shall be marked with chalk.—"Hitching O. K."

Removal.

4. In case defective cars are found within the mine, these cars are to be brought to the surface singly, properly secured by a wire rope (not to be brought out on regular trip).

Dumper to Inspect Daily.

5. The man on the dump (preferably the coupler) is to be charged with the responsibility of watching for defective drawbars. Any cars found defective are to be marked and set out immediately; they must not under any circumstance be returned to the mine without a shop O. K.

Setting Out of B. O. Cars.

6. Rope riders, motor men and all haulage men are to be instructed to watch for defective hitchings and, if found, they are to be marked and set out. (They must not be taken out unless properly secured by wire rope.)

Monthly Examination and Report.

7. These inspections shall be made monthly and a report of such inspections forwarded to the General Manager.

Pit Car Brake Inspection.

8. Monthly inspection will include mine car brakes and the report should state definitely the number of brakes inoperative at the time of the inspection. If, at any time, as many as five per cent of the total mine cars have defective brakes, the total number will be taken out of service at once and not returned until repairs have been made.

MINING MACHINE INSPECTION

Monthly Examination and Report.

1. A monthly inspection shall be made by Machine Bosses of all mining machines and equipment pertaining thereto. Reports of these inspections shall be forwarded to the General Manager in Rock Springs.

Selection of Jack-pipes.

2. Particular attention shall be paid to jackpipes to see that they are of the proper length and of such construction to best perform the duties to which they are assigned.

B. O. Jack-pipes.

3. Jackpipes with broken "fishtails" will be considered defective and shall either be repaired or retired from service.

Grounding Machines.

4. Machines will be inspected to see that grounds are properly attached as called for in the Code of Standards.

Use Of Cutter-bar Guards.

5. Machines equipped with cutter-bar guards will have the guards in place and in working condition.

Repair Defective Equipment.

6. All defective equipment will be immediately repaired.

Non-Use of Defective Equipment.

7. No machine which, in the opinion of the Machine Boss, is unsafe will be allowed to operate. If repairs cannot be made at once, the machine will be considered as out of service until repairs have been made.

MINE TRACK STANDARDS

Standard Track Diagrams.

The Mine Superintendent at each property must see that each Foreman and assistant is supplied with copies of track data and turnout diagrams. Each mine employe who may have supervision of track is to be provided with a copy of track standards. In cases where data is insufficient, or there may be a doubt as to their meaning, the engineer of the property will supply the information.

Safety of Installation.

1. Safety is, in each case, the first consideration and all installations must be made with this in view. All switches, frogs, guard rails or other track equipment where a person may be liable to receive injury is to be properly blocked or guarded. This is to apply to both inside and outside track.

Type.

2. Switch throws are to be of the "parallel" type with a ground throw. No new installations are to be made with switch stands.

Switch Throw Installations.

3. Switch throws or other devices shall not be installed on the same side of the track as the trolley.

TRACK CLEARANCE AND SHELTER HOLES

Minimum Clearance.

1. In all haulage ways and rooms hereafter constructed or developed, in which mine cars are operated, a minimum clearance of not less than twenty-four inches shall be established and maintained, on the operating side, between the point of widest dimension of the mine car, and the rib, timber, over-cast, or other condition that restricts clearance.

Room Necks.

2. Room necks are to be so turned and track so laid as to give a clearance of not less than distance shown in rule 1.

Partings.

3. Parting tracks are to be provided with the above standard clearance. The minimum distance between track centers on side or parting tracks will be such that there will be not less than 18 inches clearance between cars, or cars and prop, when cars are standing on the parting. (See Fig. 45, Page 127.)

Switch Throws.

4. Opposite all switch throws on any track at any place the track must be given not less than standard clearance.

Panels.

5. Panel slope tracks shall be so laid as to give the proper standard clearance on both sides of the track for the entire length of panel.

Long Straight Runs.

6. On long, straight runs of locomotive and rope haulage the clearance will be required on one side only but this clearance must not alternate from side to side of the track.

Use Of Flagman.

7. In all haulage ways not having full standard clearance where trips have to be moved temporarily by horses, motors or hoists, there shall be a flagman who shall go ahead of each trip, flagging and stopping the trip until pedestrians have reached a place of safety, that is, where there is sufficient clearance to prevent an accident.

Authorized Exception.

8. In places where clearance cannot be provided, such as partings and turnouts which are heavily timbered, or where permanent overcasts have been put in, which it would not be desirable to change, these places shall be properly lighted, whitewashed, and a sign illuminated by a red light shall be posted noting that there is insufficient clearance.

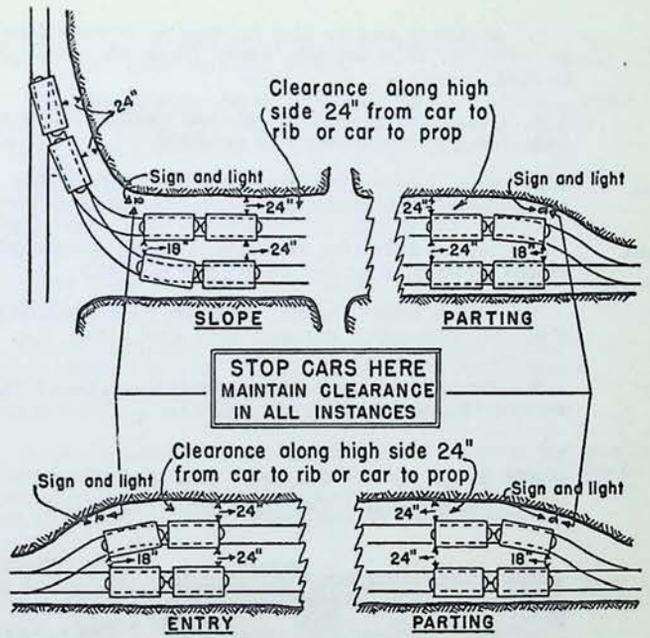
9. Shelter holes shall be provided along haulage entries where locomotive or rope haulage is used. Such shelter holes shall be spaced not more than 80 feet apart. Except where the trolley wire is 6 feet or more above the road-bed or guarded effectively at the shelter holes, they shall be on the side of the entry opposite the trolley wire.

10. Shelter holes shall be at least 5 feet in depth, not more than 4 feet in width and 6 feet in height, or as high as the traveling space, if the traveling space is less than 6 feet high. Room necks and cross-cuts may be used as shelter holes even though their width exceeds 4 feet. (See Fig. 22, page 65.)

11. Shelter holes shall be provided at all switch throws.

12. At each landing of a slope where men are passing and cars are hauled a shelter hole at least 10 feet deep, 4 feet wide and 6 feet high shall be provided.

13. Shelter holes shall be kept clear of refuse and other obstructions.



24" clearance between cars or cars and props except at ends of parting where this may be reduced to 18" but trips must not be left standing beyond this point.

STANDARD CLEARANCE
SLOPE AND ENTRY PARTINGS

Fig. 45

TRACK TIES AND RAIL JOINTS

Spacing.

1. Ties must be laid on all haulageways (locomotive, rope and animal) at intervals not to exceed two-foot centers. (This implies 60-lb. steel on main slopes, 40-lb. steel on locomotive haulageways.)

Alignment.

2. Where ties of uneven length are used they should be aligned on the ditch or low side of the track.

Graded Lengths.

3. Standard square ties in graded lengths shall be provided for each turnout where 40-lb. and 60-lb. steel is used.

Joint Ties.

4. Joint ties should be selected that have an extra wide face, where a choice is possible.

Removal.

5. Ties removed that cannot be used for other purposes should be loaded and sent out of the mine at once.

Fishplates.

6. Where fishplates are used, a selected tie shall be placed directly under the joint. (See Fig. 46.)

Splice Bars.

7. Where splice (angle) bars are used the rail joint shall be suspended between two ties. (See Fig. 46.)

Length.

8. In no case shall ties extend less than 8 inches beyond the outside web of rail.

36" Gauge—5 ' Tie never less than 5'—0".
42" Gauge—5½' Tie never less than 5'—6".

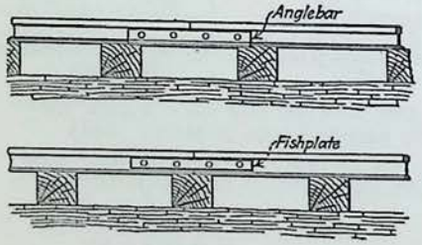


Fig. 46—Two Forms of Rail Joints.

The suspended joint is used with angle bars but the bars are supported at each end by a tie. Fishplated joints are made directly over a selected tie, as shown in the illustration.

Tie Thickness and Width.

9. All ties should have two parallel faces, the minimum width of which should not be less than 4 inches and in no case should slope and main haulage road ties be less than 6 inches thick. Room ties should not be less than 5 inches thick.

RAILS AND SPIKES

Broken Joints.

1. All track must be laid with broken joints; that is, the joints of one line should be as nearly opposite the centers of the rail on the opposite line as practicable.

Minimum Rail Length.

2. No rail less than ten feet in length will be permitted on any main haulage roads.

Spikes

3. The practice of placing spikes where employes can help themselves will not be allowed. Spikes should be issued by the Foreman or his assistants as needed.

Spiking.

4. Spikes should be staggered, that is, those on the outside of the rail should be placed on one side of the tie and those on the inside of the rail on the opposite side of the tie. (See Fig. 47.)

Gauge and Level.

5. Each Foreman and Assistant Foreman is to provide himself with and carry a clinometer rule.

6. On straight runs of track the gauge shall be held at right angles to the track and the rail held tight against the gauge and spiked. Any allowance given for clearance shall be made on the gauge length.

Superelevation On Curves.

7. Superelevation of rails on curves will be given by the engineer at the property, as the gauge of track, velocity of trip, and radius of curvature are determining factors entering into the calculation of each individual case.

Gauge On Curves.

8. For increase of track gauge on curves not more than ½ inch should be allowed, which is about the maximum for various wheel bases, wheel tread, curve radii, etc.

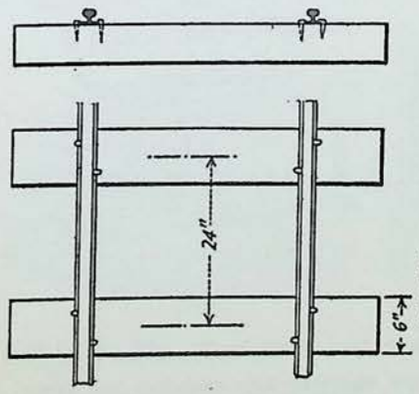


Fig. 47

Spikes will be staggered so as to obviate the possibility of splitting the ties and causing the rails to become loose.

NOTE: Maximum theoretical clear span allowable with 40-lb. steel and a 10-ton locomotive is 24 inches.

9. Each trackman's gauge for each property shall be of a standard length, viz., even gauge, leaving nothing to the guess or allowance of the workman.

Reclaiming of Spikes.

10. Spikes in abandoned, worthless ties must be reclaimed by burning, after having been sent out of the mine.

Record of Derailment.

11. A record of all derailments shall be kept by the Mine Foreman giving date, cause and location. Rope Riders and Motormen shall give their reports of such happenings to the Mine Foreman daily.

Steel Weight and Section.

12. Rails shall be of two weights only, viz., 40-lb. and 60-lb. of A. S. C. E. Section. 60-lb. rails will be used on main slopes, 40-lb. rails on panel slopes and motor haulage ways.

Spike Sizes.

13. The size of spikes for the various weights of rail shall be as follows:

40-lb. rail—4 " × ½" (605 per 200-lb. keg.)
60-lb. rail—4½" × ½" (535 per 200-lb. keg.)

CURVES AND TURNOUTS

Surveys and Lines.

1. Lines for all turnouts off main slopes and partings, together with frog and switch locations, will be given by the Chief Engineer or his assistants, and no such turnout shall be placed without his preliminary layout.

Rope Haulage Curves.

2. All curves on rope haulage shall be placed in accordance with Fig. 48, and the engineer shall give the lines and plans for this work.

3. The Mine Foreman must see that all work conforms to plans and lines as given.

Clearance.

4. All curves and turnouts are to be laid with proper reference to clearance at points where switching is done.

NOTE: Do not spoil a good track layout by making the track conform to the rib. Make the rib conform to the track.

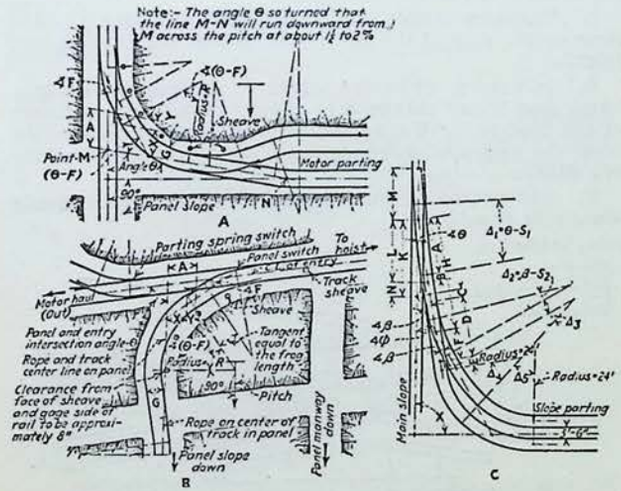


Fig. 48—Curves and Turnouts.

Lines for turnouts and partings will be given by the Chief Engineer before construction work is started. Curves on rope haulageways must be laid in accordance with the accompanying illustration. Proper dimensions are to be substituted for letters here shown.

FISHPLATES, ANGLE BARS AND RAIL BRACES

Joint Fastening.

1. All rails of any weight shall be laid with joint fastenings.

2. 40-lb. steel shall be fishplated. 60-lb. steel shall be jointed by splice (angle) bars.

3. All joint fastenings must be applied with their complement of bolts, nuts and cut washers screwed up and kept tight.

Rail Braces.

4. Rail braces should be applied to any curve where the gauge is maintained with difficulty.

5. Where rail braces are applied they should be applied to both rails.

FROGS AND SWITCHES

Nos. 3, 4 and 6 Frogs.

1. Frogs Nos. 3, 4 and 6 are to be built up and must conform to Figs. 49 to 51.

No. 6 Only.

2. No. 6 frogs will be of 60-lb. steel only and used only in turnouts off the main slope.

Turnouts.

3. Turnouts of standard material shall conform to the Standard Turnout drawings.

Conform to Rib.

4. Turnouts within the mine must be placed to conform to the ribs of the curve and not to the nearest rail joint.

Future Turnouts With Old Material.

5. In future, when the laying of a turnout with material that is not standard is contemplated, the engineer of the property will take the frog and switch dimensions from the material on the ground and compute the turnout data.

Clearance Caution.

6. The proper clearance around switch throws should always be provided.

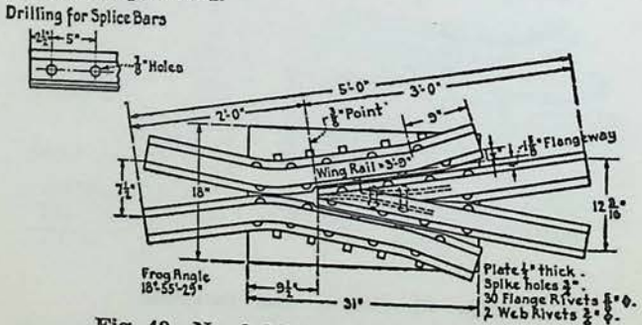


Fig. 49—No. 3 Stiff Frog for 40-lb. Rails.

RAIL—3½ in. 40-lb. A. S. C. E. Section, first quality. Drilled 2½ in. x 5 in. — ⅞ in. holes. FLANGE RIVETS—⅝ in. diameter, 30 total, to be spaced about as shown. To be countersunk on bottom, flush with plate.

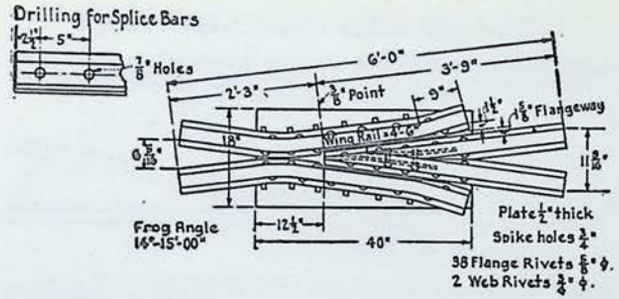


Fig. 50—No. 4 Stiff Frog for 40-lb. Rails.

RAIL—3½ in. 40-lb. A.S.C.E. Section, first quality. Drilled 2½ in. x 5 in. — ⅞ in. holes. FLANGE RIVETS—⅝ in. diameter. 38 total to be spaced about as shown. To be countersunk on bottom, flush with plate. POINT RAILS—Main point notched to take short point as shown.

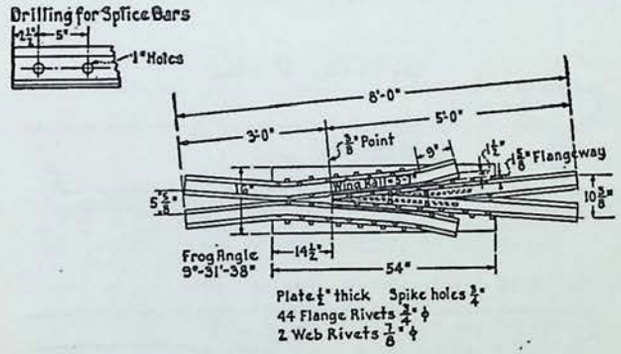


Fig. 51—No. 6 Stiff Frog for 60 lb. Rails.

RAIL—4¼ in. 60-lb. A.S.C.E. Section, first quality. Drilled 2½ in. x 5 in. — 1 in. holes. FLANGE RIVETS—¾ in. diameter. 44 total, to be spaced about as shown. To be countersunk on bottom, flush with plate. POINT RAILS—Main point notched to take short point as shown.

Present stocks of frogs on hand at the districts will be used. Subsequent orders for frogs shall comply with A. S. C. E. standards as shown on foregoing pages.

GUARD RAIL INSTALLATION

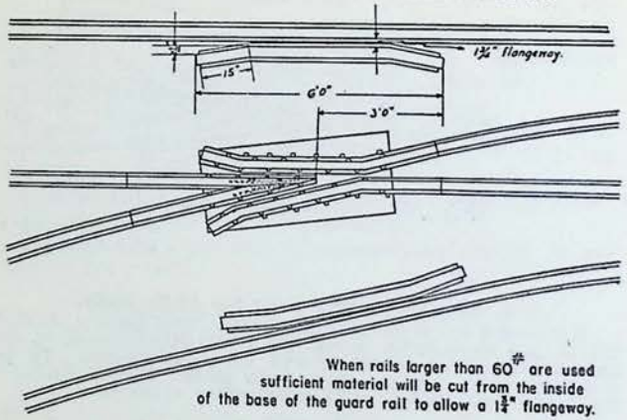


Fig. 52

GUARD RAILS

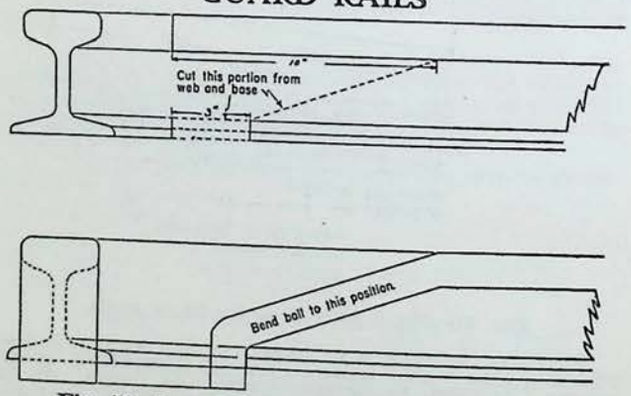


Fig. 53—Preparation of Ends of Guard Rails.

Properly constructed and installed guard rails reduce wear and tear on hoisting ropes and reduce to a minimum hazards and delays due to derailments at turnouts.

CURVATURE OF TRACK RAILS

Middle ordinates for curves of various radii, on chords of various lengths.

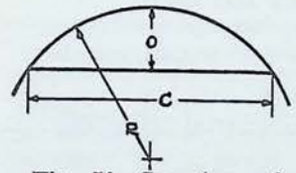


Fig. 54—Curvature of Track Rails.

$R = (36\ C^2 + O^2) \div 24\ O$
wherein

R = Radius of curvature in feet

C = Length of chord in feet

O = Middle ordinate in inches

Radius (R) Feet	Length of Chord (C), Feet						
	5	10	15	20	25	30	50
	Height of Middle Ordinate (O), Inches						
4	10.53	.....	.....	.....	.....	.....	.....
5	8.04	60.00	.....	.....	.....	.....	.....
6	6.55	32.20	.....	.....	.....	.....	.....
7	5.54	25.21	.....	.....	.....	.....	.....
8	4.81	21.06	62.59	.....	.....	.....	.....
9	4.25	18.20	48.30	.....	.....	.....	.....
10	3.81	16.08	40.63	120.00	.....	.....	.....
12	3.16	13.19	31.64	64.00	.....	.....	.....
15	2.52	10.29	24.12	45.84	80.50	180.00	.....
20	1.88	7.62	17.51	32.15	52.65	81.25	.....
25	1.40	6.06	13.82	25.05	40.19	60.00	300.00
30	1.25	5.04	11.43	20.59	32.74	48.23	161.00
50	.75	3.01	6.79	12.12	19.05	27.64	80.39
75	.....	2.00	4.51	8.04	12.59	18.18	51.47
100	.....	1.50	3.38	6.02	9.41	13.58	38.10
125	.....	1.20	2.70	4.81	7.52	10.84	30.31
150	.....	1.00	2.25	4.00	6.26	9.02	25.18
200	.....	.75	1.69	3.00	4.69	6.76	18.82
250	.....	.60	1.35	2.40	3.75	5.40	15.04
500	.....	.30	.68	1.20	1.88	2.70	7.50
750	.....	.20	.45	.80	1.25	1.80	5.00
1000	.....	.15	.34	.60	.94	1.35	3.75

RAILS, SPLICES, BOLTS AND SPIKES

Per 1,000 feet of Single Track

Rails, Splice Bars and Bolts

Rail Length Feet	Number of Rails	Number of Splice Bars	Number of Bolts	
			4 per Joint	6 per Joint
18	111	222	444	666
20	100	200	400	600
22	91	182	364	546
25	80	160	320	480
27	74	148	296	444
30	67	134	268	402

Spikes

Ties Spaced 2 Ft. on Centers; 4 Spikes per Tie.

Spike Size Under Head Inches	*Average Number per Keg of 200 Pounds	Spikes per 1,000 Feet of Single Track		Rail Weights. Pounds per Yard
		Pounds	Kegs	
2½ x ⅜	1,650	243	1¼	8 to 16
3 x ⅜	1,380	295	1½	12 to 20
3½ x ⅜	1,250	325	1⅝	12 to 20
4 x ⅜	1,025	395	2	16 to 25
3¼ x 7/16	890	455	2⅜	16 to 25
4 x 7/16	780	515	2⅝	20 to 30
4½ x 7/16	690	585	3	20 to 30
4 x ½	605	665	3⅜	25 to 35
4½ x ½	518	775	3⅞	25 to 35
5 x ½	475	850	4¼	35 to 40
5 x 9/16	405	995	5	40 to 56
5½ x 9/16	360	1,120	5⅝	45 to 90
6 x 9/16	320	1,250	6¼	50 to 100

*Variation of 10% with different makers. Verify when ordering and allow for extras.

RULES FOR THE WEIGHING OF COAL

Bond. 1. The Weighman (Company Weigh Boss) must be bonded in the sum of five hundred dollars ($500.00).

Penalty. 2. Sec. 23-160, Coal Mining Laws of the State of Wyoming:—"The weighman employed at any mine shall subscribe an oath or affirmation before a justice of the peace or other officer authorized to administer oaths, to do justice between employer and employe and to weigh the output of coal from miners in accordance with the provisions of Sec. 23-159. Said oath or affirmation shall be conspicuously posted in the weigh office and any weigher of coal or person so employed who shall knowingly violate any of the provisions of this chapter shall be deemed guilty of a misdemeanor and upon conviction shall be punished by a fine of not less than $25.00 nor more than $100.00 for each offense, or by imprisonment in the county jail for a period of not to exceed 30 days or by both such fine and imprisonment."

Oaths. NOTE: Oaths shall be made in duplicate, one copy of which is to be filed with the Mine Superintendent.

Scales Examination. 3. Sec. 23-162.—"At every mine where the coal mined is paid for by weight it shall be the duty of the weighman and the check-weighman to examine and balance the scales each morning and in no case shall any coal be weighed until such scales are tested by the United States standard weights and found correct, etc."

Test Weights. NOTE: Eight 50-lb. weights shall be kept at pit scale for the testing of the same.

Mine Inspector's Duty. 4. As provided in Sec. 23-162: "The Inspector of Mines upon each regular visit to each mine shall test the scales used for the weighing of coal."

NOTE: It shall be the duty of mine officials to insist upon this inspection.

Platform Clearance. 5. Each pit scale platform shall have at least a ¾-in. clearance, and this shall be closely watched during the working shift to see that nothing lodges in the recess that may cause the scale to bind.

Report of Bad Order Scales. 6. Whenever it is believed that any scale does not function properly, it shall be the duty of the Weigh Boss to immediately notify the Superintendent, who in turn will cause the Scale Inspector to make the proper examination and repair.

Counterpoise Construction. 7. The counterpoise of any scale beam that contains shot, nuts, etc., for balance shall be so constructed that it will be inconvenient to add or remove any of these small weights.

Equipment On Scales.

8. No equipment should be allowed to stand on the scale except while being weighed.

Loafing in Weigh Room.

9. No one except the Weigh Boss and Check-Weighman or properly accredited officials shall be allowed within the weigh room while coal is being weighed.

10. When the scale is not in use the beam catch shall be kept closed.

11. The Weighman's room on the tipple shall be so constructed that he can see the entire car as it moves across the scale.

TRACK SCALES

Forcing Balance On Weight Sheets.

1. UNDER NO CONDITION MUST TRACK SCALE WEIGHTS BE ALTERED IN ORDER TO OBTAIN A CHECK WITH THE BULLETIN.

Maintenance of Track Scales.

2. The Weighman shall keep the beams of all railroad track scales clean and free from rust, familiarize himself with the construction of scales and make inspections at such intervals as are necessary to determine if scales are in proper working condition, and that scale pits are clean and dry.

Balancing.

3. Scales shall be properly balanced before using, and the beam fastened with the beam catch while equipment is being moved on and off scale platform.

Weighing of Cars.

4. Cars must be stopped on the scales and uncoupled at both ends while being weighed.

5. Equipment should not be allowed to stand on scales except while being weighed.

Locomotives.

6. Locomotives and other equipment not to be weighed shall be passed over the dead rail.

Non-Use of Salt for Thawing.

7. Salt must not be used in removing ice and snow from the mine scales.

Responsibility.

8. The responsibility for the accurate functioning of all scales shall rest with the company Scale Inspector, who shall make the circuit of all districts at least once each month, examine each scale, and file with the General Manager a report of his inspection.

RULES GOVERNING THE EMPLOYMENT OF MEN

When necessary to employ men for service in and about the mines of The Union Pacific Coal Company, the following rules will govern:

Employment. Where Obtained.

(A) All men required for mine service with The Union Pacific Coal Company will be employed through the office of General Manager at Rock Springs. In case of emergency the Superintendent at Hanna may, after obtaining the permission of the General Manager, employ a limited number of men, complying fully with the regulations set out herein.

(B) Since every person employed in and about a coal mine possesses potentialities for accident or disaster, it is imperative that new employes be selected who are physically and mentally alert. The action or inaction, as the case may be, of one employe may not only result in the injury or death of the person responsible, but, due to the interdependency that exists between mine employes, the lives of many fellow workers may be jeopardized or even sacrificed by the failure of the one.

Good Conduct Necessary to Employment.

(C) The work of mining coal is definitely hazardous. Men who seek employment with this company and who show evidence of, or who bear the reputation of being dissipated, should be refused employment and each and every applicant who is considered for employment should be warned that drunkenness, absence from employment without due cause, or any conduct prejudicial to good citizenship will result in dismissal. A conviction in a Court of Law for a criminal offense will constitute cause for dismissal. Whenever practicable, men who are citizens of the United States or who have declared their intention to become citizens should be selected for service with this company. Men who are newly arrived from foreign countries, and who have complied with the Immigration Regulations and who are taken into the company's employ, should be aided and encouraged toward citizenship.

Citizens and Declared Citizens Preferred.

Age Requirement.

(1) No person will be employed for service in or about the mines who has not attained the lawful age of eighteen (18) years. No person will be employed for service in or about the mines of The Union Pacific Coal Company who has passed the age of fifty (50) years, without the written authority of the General Manager.

Physical Defects.

(2) The loss of sight in either eye, impaired sight or hearing, serious impairment of the heart or respiratory

organs, hernia, the loss of a hand or foot or serious impairment of a hand or foot, or other serious physical defect shall be a bar to employment.

Form 254.

(3) All applicants for employment will fill out and sign an "Application for Employment," Form 254, applicant's signature to be witnessed by officer accepting same.

Form 205.

(4) Each applicant for employment will fill out and sign "Record Card," Form 205, giving thereon his true name, age, marriage relation, and other information required for the identification of the applicant, this form to be copied by the employing agent, who will retain the original, furnishing the Superintendent or other officer in charge of the mine with a true copy of same. The subsequent record of the employe must be entered in the space provided on the card by the Superintendent or other officer in charge of the mine, who will also give complete record of such changes to the employing officer.

Form 269.

(5) PERSONAL RECORD OF SERVICE OF EMPLOYE. This form will be prepared in the office of the General Manager, in duplicate, from application Form 254, and other records of service of employe. The original will be retained for permanent record in the files of the General Manager, the duplicate forwarded to the Superintendent for record.

Form 143, Eye Examination Card.

(6) With the completion of the requirements set forth in Rule 3, Form No. 143, "Medical Examination Blank," and "Eye Examination Card", Form 37, will be given to applicant with instructions to present same to designated physician, or physicians, who will, at the expense of the company, make the examinations required. The examination reports will be retained by the General Manager as a permanent record. A duplicate of the eye examination card, Form 37-A, will, however, be forwarded to the Superintendent for record.

Notification of Employment.

(7) When a satisfactory examination has been passed and proper references covering past service of applicant have been obtained, notification of employment will be filled out in duplicate, one copy to be given to the applicant for presentation to the Superintendent designated, the second copy retained by the General Manager.

Form 41.

Upon receipt of notification of employment, the Superintendent will prepare Form 41, in duplicate, handing the original to the applicant, who will present it to the Foreman in charge. The Foreman will designate check number on Form 41, sign, and return it to the mine office. The second copy of this form is retained by the Superintendent for record.

Protective Clothing and Goggles.

(8) It will be the duty of the Superintendent to see that all new employes provide themselves with the proper designated protective clothing and goggles before they are allowed to enter the mine.

Rules and Regulations.

The Superintendent will also see that every employe is provided with a copy of the Rules and Regulations for the Government of All Employes of The Union Pacific Coal Company, for which he will be required to sign a receipt, the receipt to be forwarded to the office of the General Manager for filing. This book should be in the possession of the applicant before he is assigned to duty or given an order (Form 41) to the Foreman for work.

Order For Check-off.

(9) When applicant is finally listed for employment and before he enters same, the continuing authority for check-off for Union dues and assessments must be filled out and signed in the mine office by the applicant, the form agreed to by the Company and the Union to be used.

Transfer Blank Form 153.

(10) When it is necessary to transfer an employe from one mine or department to another in the same district, "Transfer Blank," Form 153, will be filled out in duplicate by the Superintendent making the transfer, one copy to be furnished to the Foreman in charge of the mine or department to which the employe is transferred, the second copy to be retained by the Superintendent making the transfer.

When transfer of employes is made from one district to another, "Transfer Blank," Form 153, will be filled out in duplicate by the Superintendent making the transfer, the original to be handed to the employe who will secure the approval of the General Manager thereon, it then to be handed to the Superintendent in charge of the district to which he is being transferred. The Superintendent making the transfer will retain a carbon copy of the Form 153 for his record.

Form 205 Left Service.

(11) When an employe leaves the service of the company, whether by resignation, death, or dismissal, the reverse side of the employe's Record Card, Form 205, must be filled out in detail by the Superintendent, a copy of all cards with record of death, resignation or dismissal covering employes to be thereafter forwarded to the office of the General Manager at Rock Springs.

Emergency Employment.

(12) When an emergency arises and men are employed by the Superintendent at Hanna, the regulations herein prescribed will be carried out in detail and all forms required by rules above will be forwarded by first

mail to Office of General Manager at Rock Springs, where the requirements will be completed and made of record.

Age Limit Not to Apply to Men in Service.

It is not the intention of this company to exact physical examination certificates from men in the service at date of promulgation of the above rules, nor will men be removed on account of age. On the other hand, the utmost consideration will be given old employes whose physical capacity has been impaired by age or disability.

REPORTS OF INJURIES TO EMPLOYES

Form 266.

Form 266. REPORTS OF INJURIES TO EMPLOYES. This report must be made in all cases of accidental injury, in and around the mines, regardless of the seriousness of the injury or resultant disability. It will be prepared, in triplicate, by the official in charge of the section in which the injury occurred, the original to be forwarded on the day of the injury to the Superintendent, who will ascertain the completeness of the information required, immediately thereafter forwarding the report to the office of the General Manager. The second copy of this form is to be completed and returned to the office of the Safety Engineer as soon as injured employe returns to work, showing additional information requested at the lower left-hand corner of the form. The third copy is to be retained by the Superintendent for record.

Permanent record of Forms 266 are filed in the office of the General Manager.

Form 236.

Form 236. JOINT REPORT OF SURGEON AND MINE FOREMAN. This report should be prepared by the surgeon, in triplicate, two copies to be forwarded to the Superintendent who will have the report completed by the Mine Foreman or his assistants at the close of the next working day, thereafter forwarding one copy to the General Manager, retaining one copy for his record.

This report should not be held in the mine office pending receipt of any other reports in connection with any case.

If, upon investigation, there is any doubt in the mind of the reporting official that the workman received injury while engaged in the duties of his regular occupation, in or around the mines, or he has information which would lead him to believe that workman was injured at a time and in a manner not having any connection with his regular employment, he should make a full statement in his report.

Names of persons interviewed in connection with any claim or injury, and the name or names of any witnesses to the accident, which workman claims was the cause of his disability, should be given.

Form 67.

Form 67. FOREMAN'S REPORT OF INJURY. This report should be made by the Foreman, in duplicate, in all cases of lost-time or compensable injuries, in and around the mines, the original of the form to be forwarded to the General Manager, the copy to be retained by the Superintendent.

All questions on this report should be answered fully and to the best of his knowledge by reporting official, especially those referring to workman's habits, efficiency, etc.

Form 150.

Form 150. PRIMARY REPORT OF PERSONAL INJURY. This report should be furnished in duplicate by the surgeon attending the injured workman. Upon receipt of this form by the Superintendent it should be checked carefully to see that all the required information is supplied, the original then to be forwarded to the General Manager, the copy to be retained by the Superintendent for his record.

Form 12 of Wyoming Compensation Department.

EMPLOYER'S REPORT OF ACCIDENT. Whenever an accident occurs, causing injury to the workman, it shall be the duty of the Superintendent to prepare "Wyoming Compensation Department Form 12," in quadruplicate, sending three copies to the office of the General Manager who will then handle for filing with the Clerk of the District Court. This report must be completed and filed within 20 days after date of injury.

Workman's Check Number and Title of Mine Carried on All Reports.

Workman's check number and the name or number of the mine or plant where injury occurred must be carried on all reports and correspondence in connection with injury.

Form 151.

FINAL REPORT OF INJURY. In addition to information given on this report by the surgeon, the Mine Clerk or Pay Roll Clerk should certify, under "Remarks," that workman's account has not been credited for any work performed during the period of disability reported by the surgeon. If workman's account shows a credit for labor performed during this period, the dates that workman was in attendance at his regular occupation should be given, as well as the date on which he returned to work.

Whenever a serious or fatal accident occurs in or around the mines the surgeon in charge should be called at once.

Form 237.

SURGEON'S RELEASE. Whenever a workman has been absent on account of accidental injury or sickness, before again returning to work he must present a release from the surgeon in charge who must certify as to his full recovery and ability to again resume his regular duties. Mine Foreman and department heads must not, under any circumstances, allow workman to return to work without presenting this form properly approved by Mine Superintendent.

In cases of compensable injuries, or injuries in which compensation may be claimed, all workmen must present to the General Manager and Mine Superintendent, for their approval before resuming work, a release from the surgeon in charge.

Compensation Claims.

It is the duty of the General Manager to investigate all claims for compensation when the injured workman's right to compensation, or the amount of compensation claimed, is disputed, and to report the result of all such investigations to the company attorney for an opinion.

The General Manager shall keep full and complete files of reports and correspondence in connection with any awards made for the account of this company. He shall make a monthly report of all new cases filed during the month, all cases disposed of during the month, and the amount awarded on each case disposed of during the month, together with the degree of disability for which such awards were made.

The General Manager shall advise, direct and assist injured workmen, or dependents of injured workmen, in preparing and filing claims for compensation. He shall arrange for medical examinations for injured workmen, whenever necessary, to determine amount of per cent of disability when it appears that a permanent partial or a permanent total disability has been sustained by the injured workman.

Medical Advisory Board.

Such examinations shall be made by the Medical Advisory Board, which shall be made up of five Doctors, selected from among the Surgeons, Oculists and Aurists residing in and practicing their profession in Rock Springs, Superior, Reliance, Winton and Dines, Wyoming. The Doctors shall serve on the Board on an alphabetical revolving basis, one being dropped and one picked up from the alphabetical list each month. There shall also be a permanent secretary, who will handle all correspondence and records, issue calls for meetings, etc. Each member of the Board shall be paid $10 per month, this cost to be prorated among all the coal-producing companies in the Rock Springs field, on a tonnage basis, bills to be sent out by the Auditor. Meetings will be held monthly, or when there are any cases to be passed upon. The injured person, the employing company, the doctors, and all interested parties shall be furnished copies of the Board's report.

ADVANCED FIRST AID INSTRUCTIONS FOR MINERS

General Directions

When a person is injured, some one should take command and render first aid. In the past many deaths have resulted from the fact that no one took charge of the injured person. The only way to prevent this is for every employe to acquire a knowledge of first aid. The person assuming charge should look the man over carefully to find how badly he has been injured, and when fully satisfied he should proceed to give orders. Don't attempt any unnecessary movements of the patient's body or limbs. See that the injured part is in a position as nearly normal as possible, except in case of dislocation, which should be dressed in the line of deformity. Look for hemorrhage, wounds, shock, fractures, dislocations, burns, etc. In examining the injured person, do not take off his clothes in the usual way, as you may cause him unnecessary suffering and make his injury worse. If the injury is of the arm, leg or body, rip or cut the clothing from the injured part, preferably by ripping the seams. Do not move the person until you are sure or have a clear idea of what the injury is. If hemorrhage is present, stop the flow of blood. If you find a broken bone, fix the parts without undue handling. The proper treatments for different kinds of injuries are discussed under separate heads.

Be calm and quiet. Keep onlookers away from the injured person. Don't wait a moment for a doctor, as delay is dangerous. Endeavor to make the patient comfortable by doing whatever is necessary and no more. Loosen all tight clothing, especially about the neck, chest, and waist. If the injured person has a flushed face, put something under his head to raise it. If his face is pale, his head should be lowered. If the patient vomits, turn his head to one side so that the vomited matter will not get into his windpipe and choke him. Never give an unconscious person water, whisky, or other liquid, as it may enter his windpipe and strangle him; however, if the injured person is conscious give all the water he wants, but give it slowly and in sips. A seriously injured person should be kept lying down and covered with blankets, brattice cloth, or clothing of some sort. Don't give whisky or brandy as stimulants at any time, especially in connection with injuries of the head. If you have to give a stimulant to a person in shock, always use aromatic spirits of ammonia, hot coffee, hot tea, or hot water.

Look for and know exactly where the injury is before attempting to treat it. If necessary, remove some clothing, but do it by ripping the seams of the garment or by cutting the clothes. If the regular first aid materials are not at hand, make your own splints, tourniquets, stretchers, etc., of material that is near the place of accident. When you find several injuries, treat the most severe one first.

Always cheer your patient and keep him hopeful. Keep him warm with blankets, brattice cloth, clothing, hot-water bottles, safety lamps, hot bricks, or hot stones; but hot objects should be protected so that they will not burn the patient.

WHAT A FIRST-AID MAN SHOULD DO

Be calm.
Take command and give orders.
Find location of the injury.
Know what you want to do and do it.
Keep onlookers away from the patient.
Use a knife or scissors to remove clothing.
Look for red spurting blood and check it by tourniquet or by pressure of finger over blood vessel.
Look for shock; if present, lower head of patient, apply blankets and wrapped hot-water bottles; and give aromatic spirits of ammonia in water, if patient is conscious.
Look for fractures; never remove a patient, unless absolutely necessary, until splints have been applied.
Place bandage compress over compound fracture before applying splints.
Cover all wounds with bandage compress and bandage.
The fingers or instruments should not touch a wound.
Remove a foreign object from a wound, if you do not have to put your fingers into the wound or touch the edges of the wound.
Exclude air as quickly as possible from burned surfaces by using picric-acid gauze or other material.
Leave reductions of dislocations or fractures for the surgeon, except dislocation of jaw or finger.
Only part of your work is completed when the patient is ready for the stretcher.
Unnecessary or rough handling of a patient may undo all your work.
Slowly place patient on stretcher, avoiding jerky movements, and carry him to safety.

FIRST AID PRECAUTIONS

(1) An open wound should not be touched with fingers or instruments.
(2) Place only sterile dressings over a wound.
(3) Bleeding should be checked as soon as possible or the patient's life may be endangered by loss of blood or shock.
(4) Move patient only when necessary.
(5) No attempt should be made to move a patient with a fracture or suspected fracture until splints have been applied.

(6) Ample padding should be placed between limb and splint.
(7) Always treat for shock.
(8) Always test heated objects before applying.
(9) Artificial respiration should be started at once if needed and the patient is at a point free from danger.
(10) Always pull the tongue forward when giving artificial respiration.
(11) Always remove false teeth, tobacco, and chewing gum from the mouth of the unconscious person.
(12) Rip or cut clothing so that the wound may be seen.
(13) Keep air away from burned surfaces.
(14) Loose, foreign particles in and around wounds may be wiped with a sterile gauze. Always wipe away from the wound and not toward it.
(15) In first aid, dislocations of the lower jaw, fingers and toes may be reduced.
(16) Be sure that the tourniquet is loosened every ten minutes.
(17) Quids of tobacco should not be placed on a wound.

ANATOMY OF THE HUMAN BODY

Skeleton.

In order to practice first aid properly one should know something about the bones, heart, arteries, veins, small blood vessels, principal organs, and muscles of the human body.

The human body is composed of solids and fluids. The blood is about one-thirteenth the weight of the body; for instance, if a man weighs 130 pounds he will have 10 pounds of blood.

The human skeleton is the framework of the body and is composed of three parts: The head, the trunk, and the extremities. There are 202 bones in the body, but for the purpose of first aid only a few of these are here considered. There are long bones that support the body and act as levers; short bones for strength, flat bones to protect the vital organs and for muscle attachment; and irregular bones, as the backbone and the jaw.

The skull has 22 bones, of which 8 form the upper part, or cranium, and 14 the face.

The trunk is composed of the backbone, breastbone, ribs, and pelvis. The backbone is made up of 33 bones, which are joined together by ligaments, forming the spinal column, through which the spinal cord passes. The chest in front has a breastbone and 12 ribs on each side; behind is the backbone. The first 7 pairs of ribs are attached to the breastbone, the remaining pairs being attached in front to the cartilage. The lower two have no attachment in front and are known as floating ribs. All of the ribs are attached to the backbone behind. The breastbone forms the front wall of the chest and is about 6 inches long. At the upper end it is broad and on each side has a depression that fits the end of the collar bone; below it tapers to a point.

Pelvis.

The pelvis is a wide, strong, bony basin made up of the two haunch bones and the sacrum, which is the lower end of the backbone. The haunch bones form the front and the sides and the sacrum the back wall of the basin. The pelvis supports the trunk, and the lower limbs are joined to it at the hip joints.

Trunk.

The trunk is divided by a large muscle called the diaphragm into two cavities—chest and abdomen. The chest cavity contains the lungs, heart, gullet, windpipe, and large blood vessels. The abdomen contains the stomach, large blood vessels, intestines, liver, kidneys, spleen, and bladder.

Limbs.

Each upper extremity has 1 collar bone, 1 shoulder blade, 1 arm bone, 2 forearm bones, 8 wrist bones, 5 hand bones, and 14 finger bones. Each lower extremity has 1 thigh bone, 2 leg bones, 1 kneecap, 7 ankle bones, 5 foot bones, and 14 toe bones.

Joints.

Where two or more bones come together they form a joint and are held in position by bands called ligaments.

Muscles.

Muscles or flesh give shape to the body, and by shortening or lengthening they cause the parts to which they are attached to move.

Tendons.

Tendons are strong, white, fibrous cords that attach muscles to bone.

Skin.

The skin is the protective covering of the body and is the organ of the sense of touch. It also performs the function of getting rid of some of the impurities of the body. At the openings leading to or from the interior of the body it becomes the mucous membrane.

Blood Supply.

The blood carries nourishment to the different parts of the body by means of closed tubes called blood vessels, and it is kept moving by the pumplike action of the heart. It also furnishes heat and oxygen to all parts of the body and carries waste matter from all the tissues to such organs as the lungs, kidneys, skin, and bowels, whose work is to separate it and send it out of the body.

Heart.

The heart is a hollow, muscular organ about the size of a man's fist, situated in the chest behind and somewhat to the left of the breastbone. It pumps pure blood through the arteries to all parts of the body, just as a fan forces pure air through a mine. The impure blood is carried through the veins back to the right side of the heart, which sends it to the lungs to be purified, it is then returned to the left side of the heart and sent through the body again. The heart acts like a double pump, one side of which forces the fresh blood through the body, the other side forcing the impure blood to the lungs. The heart contracts, or beats, about 72 times a minute.

Blood Vessels.

The blood vessels are the arteries, veins, and capillaries, through which the blood is conveyed to and from all parts of the body. The arteries carry the blood from the heart, and they divide and subdivide until they become very small in size and are known as capillaries. These finally enlarge and join, forming the veins, through which the blood is returned to the heart. The rich, red blood flows through the arteries in spurts, forming the pulse beat, which is conveniently felt at the wrist and temples. When an artery is cut the blood spurts out in jerks and is bright red in color; when a capillary is cut the blood is brick red in color and oozes slowly from the wound; the blood in the veins is dark red and the flow is continuous.

Respiration.

Respiration means breathing, taking in pure air and driving out the impurities that the lungs have separated from the blood. The breathing apparatus consists of the nose, throat, windpipe, and lungs.

Nose.

The principal use of the nose is to warm, filter, and moisten the air before it reaches the lungs; in the nose also is the sense of smell which to a great extent warns a person of the presence of some harmful gases.

The throat is a continuation of the nose and the mouth, and at its lower end are two openings; the one behind, called the gullet, leads into the stomach; the one in front, called the windpipe, leads to the lungs.

Larynx.

At the top of the windpipe is the larynx, in which are the cords of speech by which the voice is formed. When swallowing, the larynx is closed by a flaplike covering known as the epiglottis, which prevents food and liquid from entering the windpipe.

Lungs.

The lungs are two cone-shaped bodies, which are soft, spongy and elastic. The outside of each lung is covered by a closed sac called the pleura. The inner part of the lungs communicates freely with the outside air through the windpipe. The outside of the lungs is protected from air pressure by the walls of the chest. The air pressure on the inside of the lungs expands them until they fill the entire chest cavity. If any air gets through the chest wall, or if the wall of the lungs is pierced so that air from the outside can communicate with the pleural sac, the lungs shrink, because the air pressure is equalized on the outside and inside of the chest cavity.

Blood Purification.

The purification of the blood in the lungs is readily effected, because only a very delicate wall is between the air on one side and the blood on the other, so that the gases are easily exchanged between the two. The blood in the veins from the system is brought to the capillaries of the lungs, where the air cells separate the carbonic acid gas and waste matter with which the blood is laden. A new supply of oxygen is taken up by the red blood cells.

Breathing is an act over which we have little control. It occurs in health about sixteen to twenty times per minute. Oxygen is absolutely necessary in human life. If

Breathing.

a person breathes bad air continuously, his health will break down and disease will follow. To insure health a person requires 1,000 cubic feet of air space, which is equal to the space in a room 10 feet square and 10 feet high, and the air breathed should be frequently renewed through proper ventilation. This means that the air should be kept in motion, and the relative humidity and temperature should be approximately such as insure health.

Digestive System.

The digestive system consists of a long tube which comprises the mouth, throat, gullet, stomach, and bowels, together with the liver and other glands. This tube is about 30 feet long and extends from the mouth to the rectum. Its functions are to separate the nourishment from the food, to expel the waste part from the body, and to arrange the nutritive material in a form that can be taken up by the blood and used for food by the tissues.

Excretory System.

Excretion means the removing of all waste matter from the tissues. The waste may be removed by means of perspiring through the skin, by urine from the kidneys, in carbonic acid gas from the lungs, and by the bowel movements. Life and health depend upon the body's throwing off these wastes or poisons.

Nervous System.

The different parts of the body are kept in touch with each other by the nervous system, and the functions of the organs are controlled and regulated by it. The nervous system is composed of nerves and nerve cells or centers: most of the latter are in the brain and the spinal cord. The nerves are round white cords consisting of nerve fibers, which form connections between the centers and the ends of the nerves. The fibers transmit nervous impulses and are of two kinds, according to the function that they perform. One carries sensations, such as pain, heat, and cold, and the other causes movements of the body. The nervous system plays an important part in injuries, as there would be no shock if the nerve centers were not affected.

Epilepsy.

A person in a mine may have an attack of epilepsy, and frequently this condition is mistaken and the patient is mistreated and mishandled.

Epilepsy, or falling sickness, is a nervous disorder; the patient will have a fit or convulsion and fall to the ground. The person is usually warned of the oncoming attack. He may be depressed or joyful or there may be a change in his facial expression. Often he feels a breath of air blowing on some part of the body, passing upward to his head, with pain in his limbs or internal organs (stom-

ach, etc.) or his muscles may tremble or contract.

If standing, he will cry out or scream and fall to the ground unconscious. His muscles become stiff, his head is turned to one side by jerks, and breathing for the moment is stopped; his face is at first pale, then livid. This stage lasts about one-half minute, followed by rolling of the eyes; he may bite his tongue and cheeks, and at the same time the bladder and bowels may act. This stage lasts a few minutes and the patient slowly regains consciousness and may then fall asleep.

Treatment.—Do not try to restrain his convulsive movements, but see that he does not injure himself as by falling into a fire or down a shaft. Lay the patient on his back. Remove from his mouth any foreign bodies, such as false teeth, tobacco, or gum. Cover him with blankets. Do not give him anything by mouth. Loosen all tight clothing about his neck, chest, and abdomen. Place a piece of gauze or a pad between the teeth. Dash cold water on his face and chest. Carry the patient home and have him rest.

Treatment.

If a patient tells you that an attack is coming on, you may be able to ward it off by compressing his hand firmly.

Shock.

Shock is a profound impression made on the nervous system. It occurs in more or less degree following all accidents, and in case of fright, anger, or surgical operations. Shock is dangerous and should be given prompt attention. Allowing a person to see his own injury often causes shock, especially if there is much bleeding. When a person is suffering from shock, his face is pale and has an anxious expression, the eyelids droop, the eyes are dull and the pupils large, the skin is clammy and covered with cold sweat. The injured man is somewhat stupid and takes little interest in things about him. He may suffer from nausea and vomiting. He may answer questions slowly. He may be partly or totally unconscious, or his mind may wander. Usually he is perfectly quiet and will not move unless disturbed. Breathing is shallow and feeble; the pulse is rapid and weak, and may not be felt at the wrist. When this condition is observed, send for a doctor. Place the person in a comfortable position with his head low, unless there is a fracture of the skull or severe hemorrhage from the head. Remove from his mouth all foreign bodies, such as false teeth, tobacco, or gum. Wrap the person in warm blankets, clothing or brattice cloth. If conscious, give aromatic spirits of ammonia—a teaspoonful in a half glass of water—hot coffee, hot tea, or hot water. If he is unconscious do not give him anything by mouth, but pour aromatic spirits of ammonia on a cloth and place it under his nose. Place hot-water bottles, hot bricks, or lighted safety lamps around him under the coverings, but make sure that they are wrapped with cloth or paper so as to prevent burns. If the person is unconscious he can not tell you that the bricks, bottles, or lamps are too hot. Rub his legs and arms toward the body under the blankets, but do not uncover him. A light hot-water bottle, wrapped in cloth or paper and placed over the heart, is a good stimulant.

Although shock is dangerous and commonly follows injuries, it must not be forgotten that the patient may require treatment for something still more dangerous; as, for instance, severe bleeding, which must be checked.

ELECTRIC SHOCK

Electricity causes shock by paralyzing the nerve centers that control breathing or by stopping the regular beat of the heart. Accidents from electricity are common in mines. Electric circuits used in mines carry 250 to 2,300 volts.

Electric Shock.

The symptoms of electric shock are sudden loss of consciousness, absence of respiration—which, if present, is slight and cannot be observed—weak pulse, and burns at the point of contact with the conductor of electricity. Always rescue the person as quickly as possible, being careful not to get in contact with the live wire or other conductor. Lose no time in looking for a switch to turn off the current. In the event that there is no switch near, take a drill, mine auger, bar, or piece of wire and throw it quickly across the trolley and the rail, taking particular care to release your hold of the instrument before it touches the live wire. By so doing the circuit breaker in the power house will be thrown out and the current cut off. Leave the auger or other instrument across the wire, so that the circuit breaker will be thrown out continuously. Such action may cause injury to other working parts of the mine, but when a human life is at stake all the wires should be cut if necessary. Life should come first and the mine property afterwards. A dry, long-handled shovel will be of service in removing the patient from the wire.

If no wire, drill, or other instrument long enough to reach from the wire to the rail is at hand, one may proceed to remove the victim from the live wire, but first get a dry board or piece of thick paper and put it under your feet, and protect the hand you use with your cap,

coat, or any dry, nonconducting material, so as not to make a circuit. If possible, use one hand only, placing the other behind you. If both hands are used to remove the person from the wire, make sure that both your hands and your feet are well insulated, so that you will not be caught in the same contact. Another way is to take your belt, handkerchief, coat, or piece of dry rope and loop it over the victim's foot or head if he is lying on the wire, and thus pull him off. If an ax is near at hand, use it to cut the wire, but first make sure that the handle is dry, or wrap it with a coat or other dry nonconducting material. Or you may use a board, dry cloth, or dry rope to pull the wire away from the patient.

Treatment For Shock.

Treatment.—After the person has been taken from the wire, turn him over on his face, remove all foreign bodies from his mouth, such as false teeth, tobacco, or gum, pull and keep the tongue forward, turn his head to one side, resting it on his forearm so that his mouth and nose will not come in contact with the ground, and extend his other arm forward. Do not wait to loosen his clothing. Start the Schaefer (or prone) method of artificial respiration without delay.

SUFFOCATION OR ASPHYXIATION

Suffocation.

A victim of suffocation or asphyxiation becomes unconscious, his lips and ear lobes become blue, his pulse and breathing stop, and his pupils become dilated. The cause may be something blocking the windpipe and preventing the air from getting into the lungs, or inhalation of harmful gases. Due care should be exercised by the rescuer to protect himself. Unless the air where the victim is found is good, immediately get the person to pure air and perform the Schaefer method of artificial respiration.

GAS POISONING

The most common gases found in a mine are black damp (a mixture of nitrogen and carbon dioxide), white damp (carbon monoxide), and fire damp (inflammable gas, chiefly methane).

Gas Poisoning.

Fire damp has no effect on the human system. Only when a sufficient amount has been generated to reduce the quantity of normal air present does it interfere with breathing. When present, however, in proper proportions, it is highly explosive. Therefore great care should be exercised in using naked lights.

Black Damp.

The breathing of black damp and white damp, particularly the latter, is very dangerous. Black damp is usually recognized by its action on the flame of a safety lamp. In old unventilated workings and at the bottom of sumps, in reopening old shafts, great care should be taken. When a person works in black damp he is affected not only by the damp, but also from a lack of oxygen. The symptoms of danger from breathing black damp occur far in advance, but with white damp there may be no such warning. In bad air the amount of black damp would give warning of the next and more serious danger—want of oxygen. The man working in bad air will find that his usual work is more tiring than when working in pure air, and that he will be compelled to take frequent rests. A severe headache is made worse by stooping and is often accompanied by a sick stomach. In severe cases the power of the limbs is interfered with, causing the victim to stagger. The face becomes flushed and the flush deepens and becomes bluish. Often, if only a small percentage of black damp is present and most of the oxygen has been replaced by nitrogen, the person exposed to such an atmosphere may collapse into unconsciousness with practically no warning. No man should be permitted to work where black damp is present.

CARBON MONOXIDE OR WHITE DAMP

White Damp.

Many miners state that they are able to tell the presence of carbon monoxide by the sweetish odor present. This odor is due not to the carbon monoxide, but to other decomposition products in the atmosphere, such as the volatile products given off by a fire, or such as are caused by wood rotting, or by the oxidation of coal. Although there may be only a very small percentage of carbon monoxide present in the air that is breathed, the action of the gas is cumulative; that is, the carbon monoxide is gradually but continuously taken up by the blood and displaces the oxygen, causing the body to suffer from oxygen starvation. The first decided symptoms, during rest, make their appearance only when the blood is saturated with about 30 per cent of the gas. Death occurs when the saturation attains about 80 per cent. This action of carbon monoxide accounts for many lives that have been lost.

Another feature is that if one is working in such an atmosphere, his body will store up more carbon monoxide than if he is at rest. In rescue work men may have proceeded a considerable distance in foul air before becoming affected and have had insufficient oxygen-carrying elements in the blood to bear them back to safety. White-damp poisoning steals upon its victim in such a way that he may become saturated with the damp before he is

aware of it. In some cases the poisoning takes effect suddenly. In disasters many men have been found dead in their places with their picks in their hands as if working; others have been found in positions indicating that they were taking food when overcome.

Symptoms.

The symptoms are numerous, the more prominent being yawning, giddiness, ringing in the ears, weariness, and a fluttering or throbbing of the heart, which is a late symptom. If a person gets out of impure air into good air, usually these symptoms pass off, leaving perhaps a headache, but if no attention is paid to the symptoms and the person continues working, he becomes more affected and feels that his legs are beginning to go from under him, and usually staggers around until he sinks to the ground in a semiconscious or unconscious condition.

What to Do.

All cases may not begin this way. The symptoms may come on so gradually that the body becomes full of the poison before the person is aware of it, and he falls unconscious. The person's condition from exposure to black damp is usually due to lack of oxygen in the air that he breathes. Exposure to white damp destroys the hemoglobin in the blood so that it will not carry oxygen to the tissues of the body. In treating a person who is suffering from either black damp or white damp, always administer oxygen when making use of artificial respiration. However, if the oxygen is not at hand, do not wait but start the Schaefer method of artificial respiration after the person has been removed to fresh air.

DROWNING

Drowning.

The most important essential after rescuing a drowning person is to get the water out of his lungs and stomach. Rolling him on a barrel is desirable, but as a rule a barrel is not available. As a substitute, have one man get on his hands and knees, so that the victim can be placed over the kneeling man's back, or, if you are alone with the victim, place and lock your hands underneath the patient's stomach and lift him several times, thus bending his body and allowing the water to flow out of his mouth. Later resort to artificial respiration. Usually after a person has been immersed in water for five minutes life is extinct. There have been victims that have been revived after two hours of artificial respiration.

ARTIFICIAL RESPIRATION BY THE SCHAEFER OR PRONE METHOD

Place the person on his abdomen; remove from his mouth all foreign bodies, such as false teeth, tobacco and gum; pull and keep the tongue forward; turn his head to one side and rest it on his forearm, so that the mouth and the nose will not come in contact with the ground and extend the other arm forward. If the person is thin, prepare a pad of folded clothing, blankets, or brattice cloth and place it under the lower part of his chest. Do not make this pad too thick. Do not wait to loosen the victim's clothing, but begin artificial respiration without delay. An assistant may remove all tight clothing from the victim's neck, chest, and waist; blankets, hot-water bottles, safety lamps, or hot bricks well wrapped in paper or cloth should be placed about the person by an assistant.

Kneel, straddling the person's thighs, and, facing his head, rest the palms of your hands on his loins—on the muscles of the small of his back—with your thumbs nearly touching each other and your fingers spread over his lowest ribs (see Fig. 55); with arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear on the person (See Fig. 56.) This operation, which

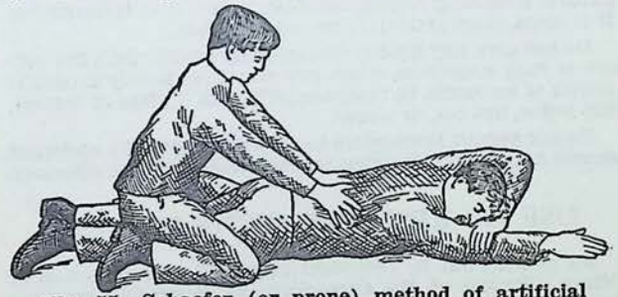


Fig. 55—Schaefer (or prone) method of artificial respiration—Inspiration.

should take three to four seconds, must not be violent, lest the internal organs be injured. The lower part of the chest and also the abdomen are thus compressed and air is forced out of the lungs. Now, immediately swing back slowly so as to remove the pressure, but have your hands in place, thus returning to the position shown in Fig. 55. Through their elasticity the patient's chest walls expand and his lungs are thus supplied with fresh air. After two seconds swing forward again and repeat deliberately, 16 to 18 times a minute, the double movement of compressing and releasing causing a complete respiration in about four seconds. If a

watch or clock is not available, follow the natural rate of your own deep breathing, swinging forward with each expiration and backward with each inspiration.

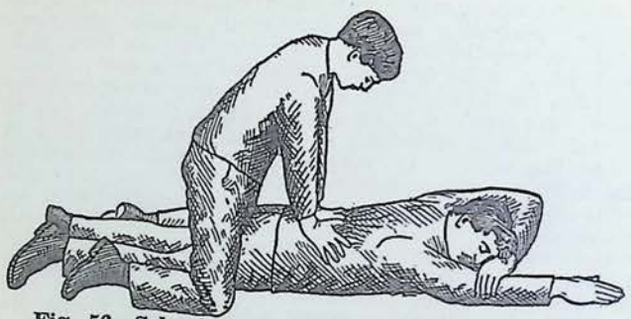


Fig. 56—Schaefer (or prone) method of artificial respiration—Expiration.

Continue artificial respiration, if necessary, for at least three hours without interruption until natural breathing has been restored or until a physician arrives. Even after natural breathing begins, carefully watch that it continues. If it stops, start artificial respiration again.

Do not give any liquids whatever by mouth until the person is fully conscious, when you may give slowly aromatic spirits of ammonia (a teaspoonful in half a glass of water), hot coffee, hot tea, or water.

Do not permit bystanders to crowd around. The assistant should not do anything that will interfere with the operator.

USE OF RESUSCITATION DEVICES

As pointed out in Technical Paper 77 of the Bureau of Mines, "Report of the Committee on Resuscitation from Mine Gases," in mild cases of respiratory failure, or even when breathing is suspended, manual methods should be used at once, because there is a chance of reviving the patient if resorted to immediately, but "if, owing to delay, the cells of the brain have been deprived of their supply of oxygen for more than the critical period (rarely more than 10 minutes), it is utterly impossible for any later treatment to restore them to their normal condition."

However, as the breathing may be so faint that it will not be detected by the layman or first-aid man, even if the person seems to be dead, it is advisable that artificial respiration be begun at once and continued until there is no hope of reviving him.

When the quantity of fresh air supplied to the patient by such artificial respiration is small or insufficient, as is likely to be the case if the patient has been breathing poisonous gases, it is advisable that the manual method be supplemented by the release of pure oxygen from a container in proximity to the patient's nose or mouth, but avoiding creating any pressure that would cause injury or prevent free exhalation. When oxygen or oxygen and air are given, the manual treatment should not be stopped, but rather continued as long as there is hope of reviving the patient.

Various machines have been devised to compel or assist artificial breathing. The committee on resuscitation above referred to considered that devices that automatically forced respiration were dangerous, and at the time of preparing this report official approval has not been given to any resuscitation devices.

HUMIDITY CHART

Diagram Showing

Percentage of Saturation and Weight of Water Vapor in Air at Different Temperatures

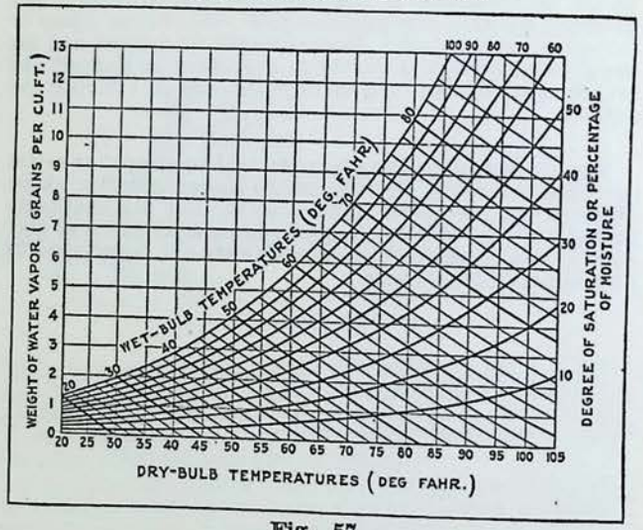


Fig. 57

This chart is used in connection with the psychrometer or wet-and-dry-bulb hygrometer. The psychrometer consists of two ordinary thermometers mounted on any convenient frame. The bulb of one of these is kept moist by a silk or muslin sack, terminating in a wick that draws up the water from a vessel below. The evaporation of the water from the sack cools this bulb and causes a lower reading of the thermometer. From the difference of the readings of the two thermometers, the degree of saturation of the air, or percentage of moisture it contains, is calculated, or this can be read directly from the chart, which shows also the weight of the moisture in grains per cubic foot.

EXAMPLE:—Suppose the wet bulb reads 54 deg. and the dry bulb 60 deg. F., follow the vertical line marked 60 up to its intersection with the straight diagonal line 54; then follow the upward curve from this point and read the percentage of saturation at the margin of the chart, which is in this case 70 per cent.

The corresponding weight of moisture is found by following the horizontal line from the same intersection and reading the weight at the left margin, which is in this case 4 grs. per cu. foot.

COMPLETE GAS TESTING DIAGRAM

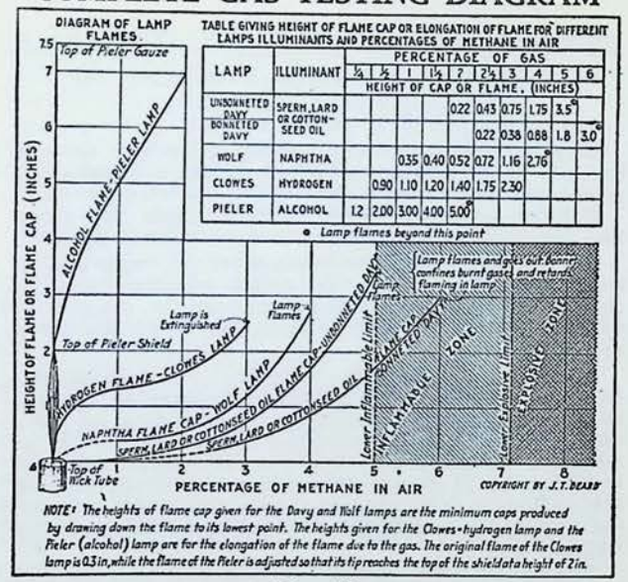


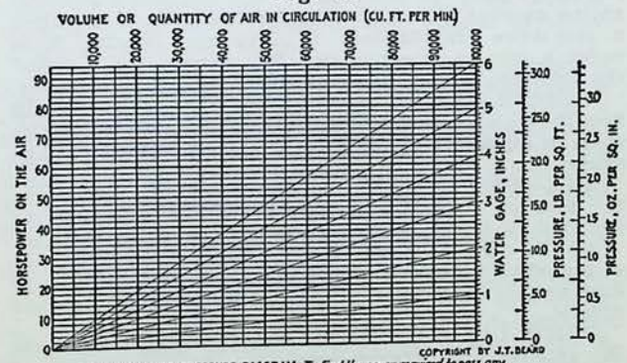
TABLE GIVING HEIGHT OF FLAME CAP OR ELONGATION OF FLAME FOR DIFFERENT LAMPS ILLUMINANTS AND PERCENTAGES OF METHANE IN AIR

LAMP	ILLUMINANT	PERCENTAGE OF GAS ½	½	1	1½	2	2½	3	4	5	6
		HEIGHT OF CAP OR FLAME, (INCHES)									
UNBONNETED DAVY	SPERM, LARD OR COTTON-SEED OIL					0.22	0.43	0.75	1.75	3.5*	
BONNETED DAVY							0.22	0.38	0.88	1.8	3.0*
WOLF	NAPHTHA			0.35	0.40	0.52	0.72	1.16	2.76*		
CLOWES	HYDROGEN		0.90	1.10	1.20	1.40	1.75	2.30			
PIELER	ALCOHOL	1.2	2.00	3.00	4.00	5.00*					

* Lamp flames beyond this point

NOTE: The heights of flame cap given for the Davy and Wolf lamps are the minimum caps produced by drawing down the flame to its lowest point. The heights given for the Clowes-hydrogen lamp and the Pieler (alcohol) lamp are for the elongation of the flame due to the gas. The original flame of the Clowes lamp is 0.3 in, while the flame of the Pieler is adjusted so that its tip reaches the top of the shield at a height of 2 in.

Fig. 58



POWER-VOLUME-PRESSURE DIAGRAM: To find the power required to pass any given volume of air against any given pressure or water gage, follow the diagonal line corresponding to the given water gage to its intersection with the vertical line corresponding to the given volume and read this point of intersection on the power scale at the left of the diagram. For example, if requires 50 hp. to pass 80,000 cu. ft. of air per minute, under a 4-inch water gage or, reversing the order, 30 hp. will pass about 96,000 cu. ft. per minute under a 2-inch gage. Since the power is proportional to the quantity and pressure alike, in order to deal with higher values than those given in the diagram, it is only necessary to treat these as multiples of the values given in the diagram. Thus, 100 hp. would pass 160,000 cu. ft. under a 4-inch gage; or 320,000 cu. ft. under a 2-inch gage. The horsepower in this diagram is the power on the air, which is commonly, in fan practice, 60 per cent. of the horsepower of the engine or the i.hp.

Fig. 59

DEFINITIONS OF ELECTRICAL TERMS MECHANICAL AND ELECTRICAL EQUIVALENTS

GENERATOR—Receives mechanical power from a turbine, steam engine or other source of mechanical power and transforms it into useful electrical power.

MOTOR—Receives electrical power from the power line and transforms it into useful mechanical power.

MOTOR-GENERATOR—Consists of a motor and a generator either coupled or belted together; used to change alternating into direct current, to change the voltage of direct current, or to change direct into alternating current.

ROTARY CONVERTER—Consists of one set of field coils and a single armature with slip rings on one end and a commutator on the other; operates from an alternating current line and produces direct current; has no means of regulating the direct current voltage. Although usually used to change alternating into direct current, the machine may be used to change direct into alternating current, in which case it is called an inverted converter.

TRANSFORMER—A piece of apparatus with no moving parts; used for changing voltage and phase of alternating current. If it is a voltage reducer, it is called a step-down transformer; if a voltage booster, it is called a step-up transformer. The power side is called the primary; the operating or motor side, the secondary.

AMPERE—Unit of current; that current which will flow through a resistance of 1 ohm with an electromotive force or difference of potential of 1 volt; letter I used as symbol.

OHM—Unit of resistance; the resistance offered to the flow of 1 ampere of current with a difference of potential of 1 volt; letter R used as symbol.

VOLT—Unit of electromotive force; that difference of potential which will cause a current of 1 ampere to flow against a resistance of 1 ohm; letter E used as symbol.

OHM'S LAW—Applied to direct current—expresses the relationship between amperes, ohms and volts as follows:

$$E = I \times R$$
$$I = E \div R$$
$$R = E \div I$$

EXAMPLE—A No. 0000 trolley wire 1,000 feet long has a resistance of .000049 ohms per foot. A shortwall mining machine motor at end of line draws 120 amperes. Find loss in voltage through the trolley wire.

$I = 120$ amperes; $R = .000049 \times 1{,}000 = .049$ ohms.

$E = I \times R = 120 \times .049 = 5.88$ volts loss.

EXAMPLE—A shunt field of a breast mining machine motor on 250 volts draws 2 amperes; machine has 2 field coils. Find resistance of each coil.

$E = 250$ volts; $I = 2$ amperes.

$R = 250 \div 2 = 125$, total resistance.

$125 \div 2 = 62.5$ ohms, resistance of each coil.

WATT—Unit of power; product of volts and amperes. 1,000 watts = 1 kilowatt. The symbol used for kilowatt is kw.

ALTERNATING CURRENT—One which alternates regularly in direction.

ALTERNATING CURRENT INDUCTION MOTOR—Two general classes, squirrel-cage and slip-ring.

SQUIRREL-CAGE MOTOR—So called on account of the shape of the rotor winding; no external electrical connection to the rotor windings. Started by two methods: (a) changing the connections of the stator winding through a star delta switch; (b) application of different steps of voltage to the stator winding through a transformer. The former method is usually used because of its simplicity. This motor runs at one speed only, which drops off slightly as the load comes on; speed is determined by the frequency of the circuit and the number of poles of the motor; characteristics similar to shunt-wound direct-current motor.

SLIP-RING MOTOR—Started in a manner similar to direct-current motor, having in series with the rotor a resistance which is gradually cut out as the motor is brought up to speed; can be run at different speeds according to the amount of resistance inserted into the circuit; used where very high starting power is required; has some characteristics similar to a series-wound direct-current motor.

CYCLE—Complete set of positive and negative values of alternating current.

EFFICIENCY—Power output ÷ power input, expressed in the same terms; always expressed in percentage and is always less than 100. For a motor, it is mechanical power output in watts ÷ electrical power input in watts; for a generator, it is electrical power output in watts ÷ mechanical power input in watts.

FREQUENCY—Number of cycles per second, indicating one-half the number of times alternating current changes direction in 1 second; standard frequencies are 25 and 60 cycles. If the frequency is 60 cycles per second we know the current changes direction 120 times per second.

PHASE—Characteristics of alternating current are determined by operating conditions.

A single-phase motor has two terminal wires and acts like a single cylinder automobile engine with infrequent applications of power.

A 2-phase motor has 4 terminal wires; twice the number of power impulses per second and has more frequent applications of power.

Where high starting power and heavy overloads are encountered in service, 3-phase power is best and has been adopted as standard for alternating current.

POWER FACTOR—Characteristics of alternating current circuits are such that there is a difference between real power available for work as measured by the wattmeter, and apparent power, which latter is the product of volts and amperes as recorded by a voltmeter and an ammeter. The ratio of real to apparent power, both expressed in watts, is called power factor, which is expressed in percentage and is always 100 or less.

Size of Wires

The area of cross-section of round wires is usually given in circular mils; the diameter, in decimals of an inch. 1 mil is 1/1000 (.001) of an inch. 1 circular mil is the area, expressed in decimals of a square inch, of a circle of 1 mil diameter.

The area of any circle, expressed in square inches, is $3.1416 \times \text{radius}^2$ or $.7854 \times \text{diameter}^2$. The area of 1 mil diameter circle is therefore $.7854 \times (.001)^2 = .0000007854$ square inches or 1 circular mil.

In other words, the area of any circle expressed in circular mils equals the square of the diameter in mils; i. e., C. M. $= d^2$.

USEFUL ELECTRICAL DATA FOR COAL MINE ELECTRICIANS AND OPERATING MEN

FORMULAS USED IN ELECTRICAL CALCULATIONS:

K. W. = 1,000 watts = 1.34 H. P.

H. P. = 746 watts = .746 K. W.

$$\text{K. V. A.} = \frac{\text{K. W.}}{\text{P. F.}}$$

$$\text{P. F.} = \frac{\text{true power}}{\text{apparent power}} = \frac{\text{Watts}}{\text{volts} \times \text{amperes}} = \frac{\text{K. W.}}{\text{K. V. A.}}$$

$$\text{K. W.} = \frac{1{,}000}{\text{E} \times \text{I}} \quad \text{(Direct Current)}$$

$$\text{K. W.} = \frac{1.73 \times \text{E} \times \text{I} \times \text{P. F.}}{1{,}000} \quad \text{(3-Phase Alternating Current)}$$

$$\text{K. W.} = \frac{2 \times \text{E} \times \text{I} \times \text{P. F.}}{1{,}000} \quad \text{(2-Phase Alternating Current)}$$

$$\text{K. W.} = \frac{\text{E} \times \text{I} \times \text{P. F.}}{1{,}000} \quad \text{(1-Phase Alternating Current)}$$

Ohms Law (Direct current or non-inductive alternating current circuits):

$$\text{I} = \frac{\text{E}}{\text{R}}, \qquad \text{E} = \text{IR}, \qquad \text{R} = \frac{\text{E}}{\text{I}}$$

Amperes per motor (Current input per line):

Direct Current $\quad \text{I} = \dfrac{\text{H. P.} \times 746}{\text{E} \times \text{Eff.}}$

3-Phase A. C. $\quad \text{I} = \dfrac{\text{H. P.} \times 746}{1.73 \times \text{E} \times \text{Eff.} \times \text{P. F.}}$

2-Phase A. C. $\quad \text{I} = \dfrac{\text{H. P.} \times 746}{2 \times \text{E} \times \text{Eff.} \times \text{P. F.}}$

1-Phase A. C. $\quad \text{I} = \dfrac{\text{H. P.} \times 746}{\text{E} \times \text{Eff.} \times \text{P. F.}}$

Wiring Formulas

$$CM = \frac{22 \times LC}{V}$$ Where load is at end of line.

$$CM = \frac{11 \times LC}{V}$$ Where load is distributed along line.

CM = Circular mils.
L = Length in feet on one side of circuit.
C = Current in Amperes.
V = Loss in Volts.

Equivalents of Electrical Units

1 Kilowatt = 1,000 Watts.
1 Kilowatt = 1.34 horse power.
1 Kilowatt = 42,257 Ft.-lbs. per min.
1 Kilowatt = 56.87 B. T. U. per min.
1 Horse power = 746 Watts.
1 Horse power = 33,000 Ft.-lbs. per min.
1 Horse power = 42.41 B. T. U. per min.
1 B. T. U. = 778 Foot-pounds.
1 B. T. U. = 0.2930 Watt hours.

Current for Motors

Amperes for Each Lead at Full Load

HORSE POWER	DIRECT CURRENT		ALTERNATING CURRENT		
			PHASE		
			Single	Two	Three
	VOLTS		VOLTS		
	110	220	208	200	200
½	4.9	2.5	4.9	—	—
1	9	4.5	7.8	—	—
1½	13.6	6.8	—	—	—
2	18	9	15.9	—	—
3	25	13	21.5	—	—
5	42	21	32.5	12.9	14.9
7½	57	28	48	19	22
10	75	38	68	25	29
15	113	57	90	37	43
20	150	75	115	49	58
30	226	113	161	72	84
40	301	150	—	96	111
50	376	188	—	118	136
60	452	226	—	140	163
70	527	263	—	163	187
80	602	301	—	185	213
90	678	339	—	207	239
100	753	376	—	230	265

Rules—Volts, Amperes, Watts, Etc.

To find the watts consumed in a given electrical circuit, such as a lamp, multiply the volts by the amperes.

To find the volts, divide the watts by the amperes.

To find the amperes, divide the watts by the volts.

To find the electrical horse-power required by a lamp, divide the watts of the lamp by 746.

To find the number of lamps that can be supplied by one electrical horse-power of energy, divide 746 by the watts of the lamp.

To find the electrical horse-power necessary, multiply the watts per lamp by the number of lamps and divide by 746.

To find the mechanical horse-power necessary to generate the required electrical horse-power, divide the latter by the efficiency of the generator.

To find the amperes of a given circuit of which the volts and ohms resistance are known, divide the volts by the ohms.

To find the volts, when the amperes and watts are known, multiply the amperes by the ohms.

To find the resistance in ohms, when the volts and amperes are known, divide the volts by the amperes.

CONVENIENT TABLES FOR MINE ELECTRICIANS AND OTHERS

Size of Fuses, in Amperes, For Motors, Equipped With Overload Starting Rheostats.

Horse Power	115 Volts	230 Volts	500 Volts
0.5	8	4	2
1	15	8	4
3	40	20	10
4	50	25	12
5	60	30	15
7.5	90	45	20
10	115	60	25
15	175	90	40
20	225	115	50
25	300	150	60
30	350	175	75
35	400	200	90
40	450	225	100
50	600	300	125

VOLTS DROP IN BONDED TRACK

Losses Per Ampere per 1,000 Feet of Single Track Rail Bonds of No. 1 Copper Wire

Weight of Rail, Pounds per Yard	Length of Bond, Feet	Volts Drop per Ampere per 1,000 Feet of Single Track			
		30-Ft. Rail Lengths		20-Ft. Rail Lengths	
		Single Bonded	Double Bonded	Single Bonded	Double Bonded
8	2½	0.0344	0.0318	0.0354	0.0317
12	2½	.0247	.0221	.0261	.0224
16	2½	.0198	.0172	.0214	.0176
20	2½	.0168	.0142	.0188	.0149
25	2½	.0145	.0119	.0166	.0216
30	2½	.0139	.0108	.0165	.0120
35	3	.0128	.0097	.0155	.0109
40	3	.0120	.0089	.0148	.0101
45	3	.0114	.0083	.0142	.0096
50	3	.0109	.0078	.0137	.0090
55	3	.0104	.0073	.0133	.0086
60	3	.0101	.0070	.0129	.0083
65	3	.0098	.0067	.0126	.0080
70	3	.0095	.0064	.0124	.0077

ELECTRICAL PROPERTIES OF MINE TRACKS

Weights of Rail per Yard	Equivalent Area in Cir. Mils of Copper	Resistance at 24° C.		Loss in Volts per Amp. in 100 Ft. Track	Safe Amp. 10° C. Rise
		Ohms per Mile	Ohms per 1,000 Ft.		
16	320,000	.1737	.0329	.0033	500
20	400,000	.1684	.0263	.0026	600
25	500,000	.1109	.0210	.0021	675
30	600,000	.0925	.0175	.0017	750
35	700,000	.0792	.0150	.0015	850
40	800,000	.0692	.0131	.0013	950
45	900,000	.0616	.0117	.0012	1,050
50	1,000,000	.0554	.0105	.0011	1,150
55	1,100,000	.0504	.0095	.0010	1,250
60	1,200,000	.0464	.0088	.0009	1,300
65	1,300,000	.0417	.0079	.0008	1,400
70	1,400,000	.0396	.0075	.00075	1,500
80	1,600,000	.0345	.0065	.00065	1,700
90	1,800,000	.0307	.0058	.00058	1,900
100	2,000,000	.0270	.0051	.00051	2,150

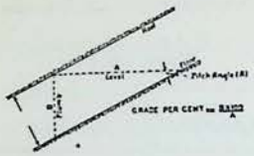
VOLTS LOST WITH VARIOUS COPPER WIRE COMBINATIONS

Sizes of Wires	Area Circular Mils	Weight of Combination, Pounds per 1,000 feet	Volts Lost per Ampere per 1,000 feet
One No. 0000 and One No. 000	379,405	1,149	0.027
" " " " " " 00	344,679	1,044	.030
" " " " " " 0	317,192	960	.033
" " " " " " 1	295,295	894	.035
One No. 0000 and Two No. 000	547,210	1,657	.019
" " " " " " 00	477,758	1,447	.022
" " " " " " 0	422,784	1,280	.025
" " " " " " 1	378,990	1,148	.027
One No. 000 and One No. 00	300,884	911	.035
" " " " " " 0	273,397	828	.038
" " " " " " 1	251,500	762	.041
One No. 000 and Two No. 00	433,963	1,314	.024
" " " " " " 0	378,989	1,147	.027
" " " " " " 1	335,195	1,015	.031
One No. 00 and One No. 0	238,671	723	.043
" " " " " " 1	216,774	656	.048
One No. 00 and Two No. 0	344,263	1,042	.030
" " " " " " 1	300,469	910	.035
One No. 0 and One No. 1	189,287	573	.055
One No. 0 and Two No. 1	272,982	827	.038

WEIGHT OF BARE COPPER WIRE

Wire No. B. & S. Gauge	Diameter, Inches	Area, Circular Mils	Weight of Bare Wire, Pounds	
			Per 1,000 Feet	Per Mile
0000	0.460	211,600	640.7	3,383
000	.410	167,805	508.1	2,683
00	.365	133,079	403.1	2,128
0	.325	105,592	319.7	1,688
1	.289	83,695	253.4	1,338
2	.258	66,373	201.0	1,061
3	.229	52,634	159.4	841.5
4	.204	41,743	126.4	667.4
5	.182	33,102	100.2	529.2
6	.162	26,251	79.5	419.7
7	.144	20,817	63.0	332.8
8	.129	16,510	50.0	264.0
9	.114	13,094	39.7	209.4
10	.102	10,382	31.4	166.0
11	.091	8,234	24.9	131.7
12	.081	6,230	19.8	104.4
13	.072	5,178	15.7	82.8
14	.064	4,107	12.4	65.7
15	.057	3,257	9.86	52.07
16	.051	2,583	7.82	41.29
17	.045	2,048	6.20	32.75
18	.040	1,624	4.92	25.97
19	.036	1,288	3.90	20.59
20	.032	1,021	3.09	16.33
21	.029	810.1	2.45	12.95
22	.025	642.5	1.95	10.27
23	.023	509.5	1.54	8.15
24	.020	404.0	1.22	6.46
25	.018	320.4	.97	5.12
26	.016	254.1	.77	4.06

PERCENTAGE AND DEGREES OF GRADE



Ratio of Rise (B) to travel along the level (A).

Grade Per Cent	Angular Equivalent (Angle A)		
	Degrees	Minutes	Seconds
1	0	34	23
2	1	8	45
3	1	43	6
4	2	17	26
5	2	51	45
6	3	26	1
7	4	0	5
8	4	34	26
9	5	8	34
10	5	12	38
12	6	50	34
14	7	58	11
16	9	5	25
18	10	12	14
20	11	18	36
22	12	24	27
24	13	29	45
26	14	34	27
28	15	38	32
30	16	42	7
35	19	17	24
40	21	48	5
45	24	13	40
50	26	33	54
55	28	48	39
60	30	57	50
65	33	1	26
70	34	59	31
75	36	52	12
80	38	39	35
90	41	59	14
100	45	0	0

FAN CHART SHOWING INTERRUPTED OPERATION FROM THE HOURS OF 9 A. M. TO 9:45 A. M.

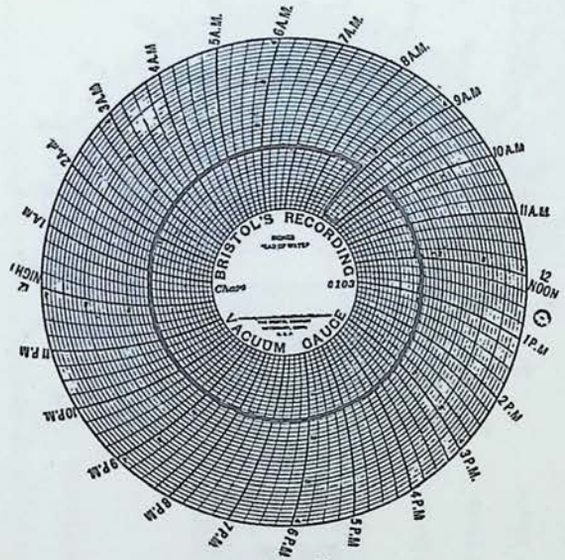


Fig. 60

NOTE: "Fan Shut Down."

FAN CHART SHOWING UNINTERRUPTED OPERATION

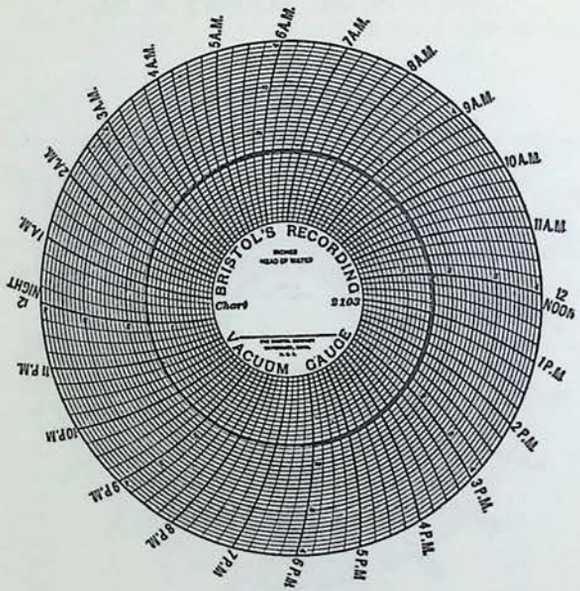


Fig. 61

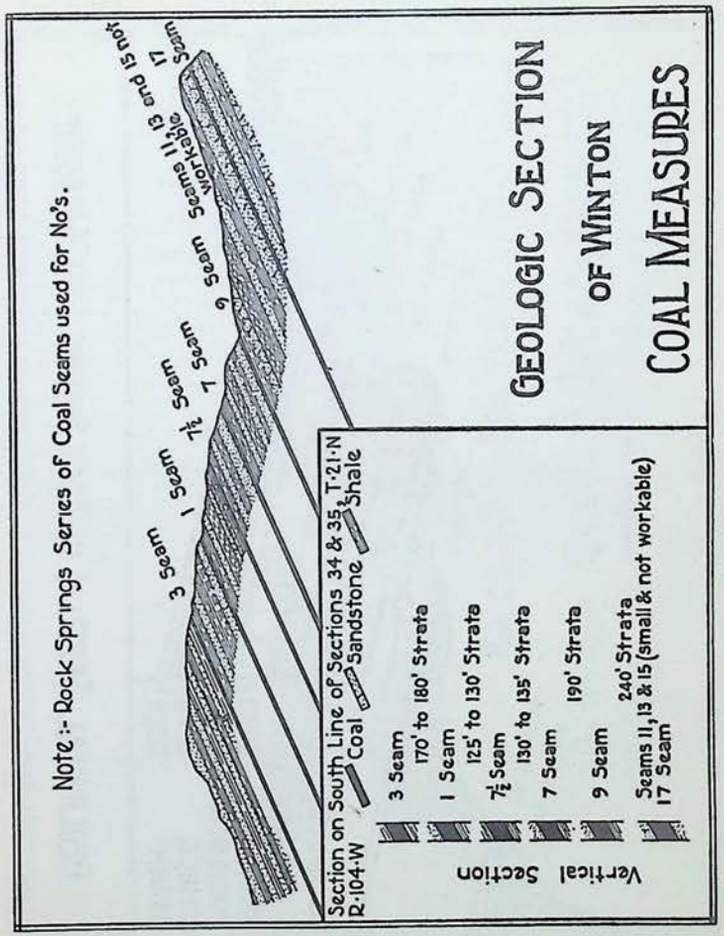


Fig. 62

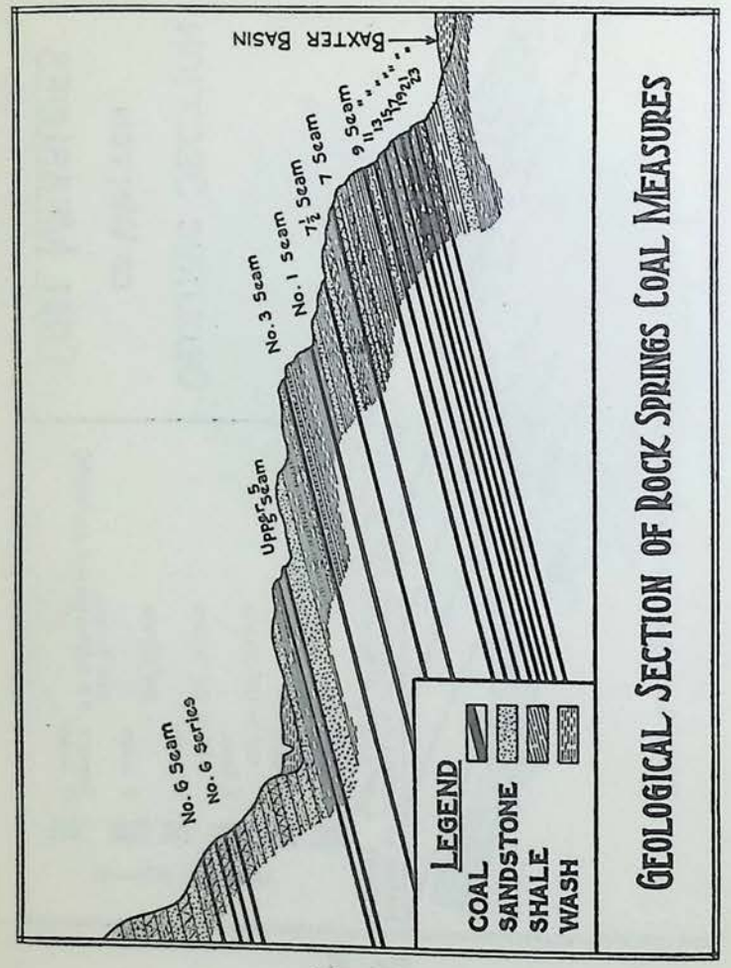

GEOLOGICAL SECTION OF ROCK SPRINGS COAL MEASURES
LEGEND
COAL
SANDSTONE
SHALE
WASH
BAXTER BASIN
No. 6 Seam
No. 6 series
Upper Seam
No. 3 Seam
No. 1 Seam
7½ Seam
7 Seam
9 Seam
11 13 15 17 19 21 23

Fig. 63

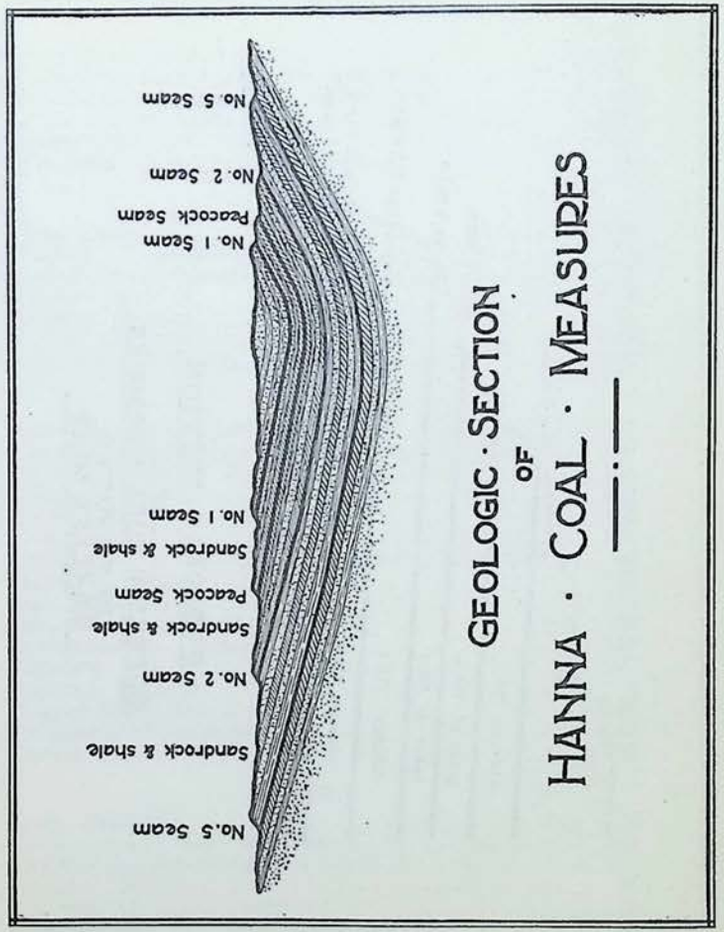

GEOLOGIC · SECTION
OF
HANNA · COAL · MEASURES
No. 5 Seam
Sandrock & shale
No. 2 Seam
Sandrock & shale
Peacock Seam
Sandrock & shale
No. 1 Seam
No. 1 Seam
Peacock Seam
No. 2 Seam
No. 5 Seam

Fig. 64

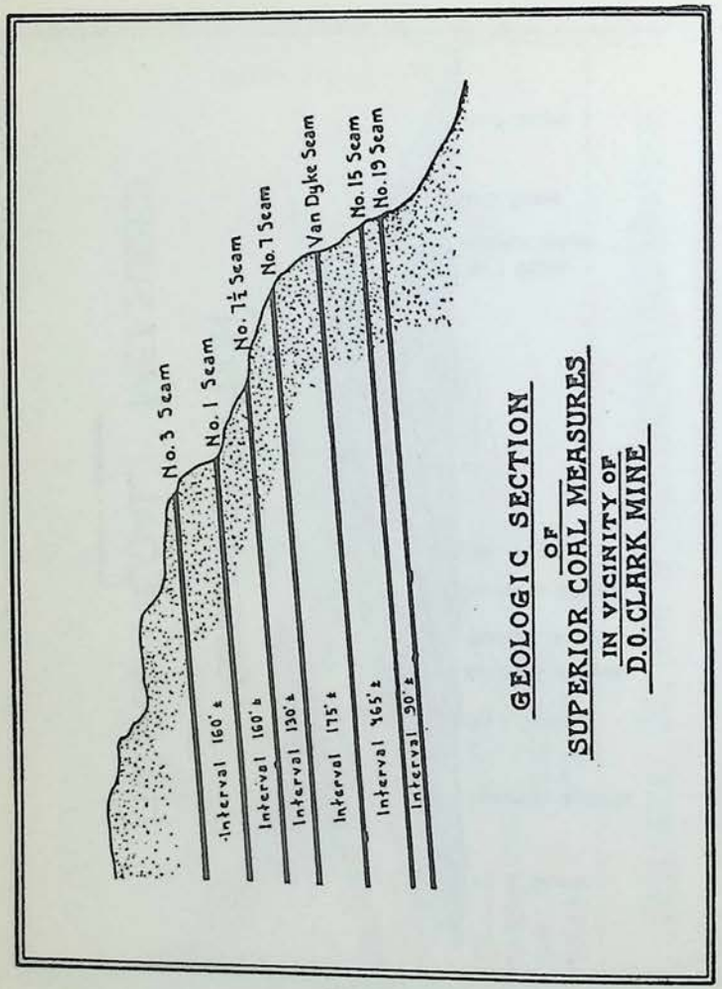


Fig. 65

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