COAL AGE

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DEVOTED TO THE OPERATING, TECHNICAL AND BUSINESS PROBLEMS OF THE COAL-MINING INDUSTRY

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Triple Challenge

ADOPTION of the shorter work-day with higher hourly rates of pay is a challenge alike to management and labor in the bituminous coal industry and also to the manufacturers who furnish equipment and supplies to the mines. Should any of these three groups fail to measure up to its responsibilities, an undue burden will be cast upon the other two. With competition from substitute fuels what it is, such a failure easily might prove disastrous to all three.

Management undoubtedly faces the severest test because upon management rests the obligation to coordinate the forces of the other two groups. Management must decide whether tonnage shall be maintained by increasing the number of working places or by increasing the hourly output per working place. In either event, with fewer hours a day to play with, the necessity for scheduling operations to reduce non-productive time to the minimum basis becomes not only highly desirable, as it always was, but imperative.

When the president of the United Mine Workers opened his successful drive for shorter hours at the February conferences for the renewal of the Appalachian wage agreements he held out to the doubting employers the promise that the reduction in the length of the working day would entail neither decrease in efficiency nor in productivity. The implication was plain that labor could mine as much coal in seven hours as had been produced heretofore in eight hours. This is by no means inconceivable, and members of Mr. Lewis' organization clearly owe it to their union to redeem the pledge of their chieftain.

Achievement of the new objectives necessarily involves new capital expenditures by the industry. This will be true regardless of the route an individual mine management may take in reaching its goals. Manufacturers of mining equipment and supplies, therefore, play an increasingly important part in helping mine management to keep the cost ceiling as low as possible. Management that does not take the fullest advantage of cooperative studies of its problems with the sales engineer of the manufacturer needlessly handicaps itself in the race for survival.

The Fourth Party

WHILE management, labor and mining-machinery manufacturers must unite to meet the new problems of the bituminous coal industry, there also is a fourth party to the new social experiment that cannot ignore its obligations without jeopardy to the success of that experiment. That party is the Government of the United States. Direct impetus was given the movement for shorter hours and higher pay by President Roosevelt in his address to the conference of code authorities on March 5; NRA lost no time in making the shorter day written into the new Appalachian wage contract the code mandate for the entire industry, although many districts were working under unexpired eight-hour agreements.

Reductions in hours and increases in pay seem inevitable if we are to continue to encourage the efficient substitution of the machine for manual drudgery and still effect the widest possible distribution of the fruits of labor-saving inventions. How fast we should move in that direction may be debatable. But when

an industry takes that step at the invitation of the government, the government cannot avoid the implications of that acceptance. Specifically in the case of bituminous coal, this means that it is incumbent upon the administration to afford the industry adequate protection against unfair and unbalanced competition from rivals not so circumscribed.

Scheduling

SET A DAY, set an hour—that is the basis of efficiency. Jobs that are to be done at convenience usually are never done. Some jobs have their value entirely in their timeliness, and such jobs should be closely scheduled, so that the man who is to perform the job will know when it is to be done and that dependence is being placed on his doing it by the time fixed. For such scheduling, a knowledge of the task to be performed, the material, force and time needed are necessary. Why not append this to specifications? Any man who orders a job done should know how long it should take, barring delays in transportation or delivery of material. Any delays in these should be subjected to investigation if the job is delayed. Knowledge of this kind is lacking at most mines. By changing the force, work to be speeded can be brought to conform to schedule, if the boss knows just what the job takes with a normal force.

Lynch Law in Washington

UNDER THE TERMS of the bituminous code of fair competition, a conference was to have been held on January 5 to consider recommendations of NRA on hours and wages. The conference did not begin until March 26 and NRA had no recommendations to offer. After four days of desultory conversations and postponements, the conference reconvened on the afternoon of March 30, when three subdivisions of Division I proposed amendments to the code establishing the seven-hour day and higher hourly rates for the entire industry. The right of the subdivisions to suggest such changes, or any others, is unquestioned.

Up to this point, therefore, there can be no valid criticism of the procedure if the charity of silence covers the delay in calling the conference and the failure of NRA to discharge its duties under Article V of the code. With the introduction of the proposed amendments, however, the picture changed. Told in one breath that the meeting was not a public hearing and that the right of protest might be reserved, but in the next breath that silence would be construed as assent and that an order would be issued next day which it would be difficult to change after it had been made public, opponents could do nothing but stir the air with formal objections to the proposals and to the procedure.

Just why orderly processes of consideration and judgment should have been kicked out of the window is still a mystery. Just why the "serious emergency," cited but not stated in the order of March 31 making the resolution part of the code pending hearing, could not have been met by an interim extension of Schedule A of the original code, with or without the particular changes already agreed upon in the new Appalachian wage contract, is still unexplained. Judgment before trial does not comport with American traditions. The order of March 31 reflected no credit upon NRA and threatened a grievous disservice to what should be a cooperative effort in social progress.

Directness

ROUNDABOUT WAYS have plagued the coal mines for many years, for only by studying maps and drawings can a clear understanding of the relation between points underground be attained. Many pertinent cases, especially in mines where measures pitch heavily and irregularly, have been found where headings had been driven to form almost a complete loop, around which coal was being hauled, when a few hundred feet of heading driven to complete the loop would have given a short and easy road to the mine mouth or shaft.

In another instance, a water-car was being used to take water out of a dip in a heading where a ditch a foot deep would have turned the trick. In yet another, in a foreign land, the foot cager signaled to a top-man by a gong when he wanted a car hoisted. The top-man carried the message to the hoisting engineer, who set his hoist in motion. When the engineers were told that the gong could be placed in the hoist house, they said they supposed it could, but such trivial ideas did not constitute engineering. Directness is the cardinal feature in efficiency, but how often is it neglected!

MANAGEMENT

+ Challenged by Demands of New Deal

SHORTER HOURS for labor offer a challenge to management that can be met only be systematized operation, under which opportunities for increased production per hour will be afforded for every man, not only in the day force but in every classification, including that of the miner. Management, therefore, should ascertain just what changes the new set-up requires, or, at least, what changes should be made, whether to accord with new conditions or merely to align with the most efficient methods.

Principle of "first things first" will make it advisable to embark first in those which promise largest results. Without knowledge of any particular mine, or without knowing what has already been accomplished, the order of revision of methods cannot be set down in black and white.

Forecasting and the construction of a forecast map and schedule, for instance, do not possess the same appeal to an operator with thick coal in an untroubled bed as they do to one with thin coal and difficult operating conditions, though everyone has some problems that should be met with some measure of forecasting, especially at the commencement of operations. It should be said that this article will deal solely with management, leaving detailed phases of transportation, cutting, loading, ventilation, etc., to be considered elsewhere.

Do Not Delay Development

Prices being fixed by code authorities for districts on the basis of operating costs, it will be important that each month's operation be loaded with the actual expense of maintenance and development. To allow these, or any other detail, to lag behind will result in costs below those which operation eventually must face and result in a district selling price being fixed so low as to wipe out profit, or even occasion a loss when later operation shows clearly that purchases must be made to replace run-down and damaged equipment, or that headings must be driven to replace those where mining has been, or is about to be, completed.

Few are less disposed than the foreman to look far ahead. His monthly cost sheet always looms before him as of paramount importance. Where coal is thin—or where it is of only moderate thickness and the extraction is only partial—development and production are continually running a race which, in many mines, is in favor of the latter. The mine, that is, is developing too slowly to maintain for any length of time the output it is producing. Surface plant, marketing facilities, transportation equipment, facilities for supply of power and all details except development may be suited to a big tonnage. With a thick seam, the mine could hardly fail to be a big producer, but because of its inability to develop, its output may be kept to a low level.

Still Waiting for Tonnage

An operator of big producing mines, whose experience had been gained in thick seams, was selected to run a series of mines in a thin-coal district. After a few months at the mines, he reported that the men, from superintendent to trapper boy, were victimized by an obsession which led them to believe that when they had a thousand-ton mine they had reached the limit of operating possibility. Years passed, and the mines he operated did not increase in output; if anything, they became less productive. Insufficient development kept them back and as they expanded in area they declined in output—the almost universal experience in thin-coal districts.

Many a thin-coal mine has been equipped enthusiastically for a daily output of some thousands of tons, and in the years that followed has been nothing more than a 500- or 600-ton mine, simply because production used up development as fast as it was created. If it had been kept running solely on development until several main entries had gained good headway, the mine might have reached the desired tonnage, but the owner was too anxious for an immediate return.

Delaying development is a sure method of beating, for a while, the monthly cost sheet. Not only can charges listed under development be cut but if rock has to be hauled, transportation costs also can be reduced. In fact, where rock is stowed in the mine, and none has to be hauled, development nevertheless will raise transportation charges, because of the lack of concentration and reduction in output that accompanies development. There are other apparent savings in the abandonment of development, because no rock has to be dumped, no switches have to be laid, no wire strung, no tracks bonded, no stoppings or overcasts erected and drainage costs are reduced.

In fact, development costs enter properly into every item, even into sales realization, for entry coal usually affords less lump than room coal. But these charges are masked, and the apparent saving derived from abandonment of development seems, at a superficial glance, to be fully covered by the item that appears under that head.

Moreover, when development is eliminated or curtailed, the apparently reduced costs for mine operation consequent on the elimination or curtailment are spread over an increased tonnage and make the cost per ton phenomenally low. Everything goes well until it is realized that production can no longer be maintained, and then it will be found that it is impossible, or nearly impossible, for development to outspeed output, and the mine for months, or even forever, will be definitely set on a low tonnage and a high cost.

High Costs With Low Tonnage

Every effort to restore output involves expense, for with a low tonnage there is reduced production over which to spread the cost; the roads are cluttered with rock instead of coal, and rock-dumping facilities become inadequate. All the savings made when development was abandoned are now replaced by costs that are equally heavy, and there is no production to carry them.

Mine management should foresee this condition and take precautions against it. Especially is it unfortunate where the mine must work steadily, for then the needed pick-up cannot be provided by advancing headings on idle days. With development ahead, it may be

possible to close some other mine and thus reduce overhead considerably. But with development behind, it becomes necessary in many cases to open up another mine to offset the lack of production in the first, and the result is—one too often seen in low-coal territory—two high-cost mines where one low-cost mine would have produced the same tonnage. If these mines come to the same tipple, long outside hauls result; large expenditure is made for mine opening and also for management.

How to Check Progress

Such losses are avoided by forecasting and by a practice of making foreman and superintendent responsible for meeting the schedule, with the clerical force watching the daily sheets and monthly payrolls to see that it is being done and jogging the memory of management, superintendent and foreman if development lags behind the program. Even then, unless the engineering force checks the mine foreman's yardage measurements, the manager may find his development is falling behind, for it is a custom, and a bad one, for the foreman, anxious to keep the men from quitting, to give consideration in measuring yardage to thinness of coal, hardness of roof or bottom, presence of spars and water, or roof that must be timbered. Meanwhile, manager, superintendent and clerical force are blissfully satisfied with the apparent progress, though conditions as to development may be getting daily more critical.

With these means of keeping posted on the progress of development, the manager needs constantly to study development problems to see if the recognized difficulties in advancing headings can be met by better ventilation with auxiliary fans or brattice cloth, more ready water removal, less cumbrous timbering, better transportation service, prompter tracklaying, or other accommodation. In some mines, development should have right of way over production. Mechanization may be, and frequently is, the only answer to the problem. But it is a fact that, in some mines, headings vital to the future of mine operation are drowned out for lack of a gathering pump. In such a mine, lowered development makes lowered production, lowered production makes high costs, high costs, make poverty, and poverty makes it difficult to get needed equipment—a vicious circle.

Especially is it important to extend with all rapidity the main arteries—those entries from which cross entries or room entries can be driven. A careful forecast may show that more than one main artery is necessary and that entries must be driven from two arteries to meet each other instead of being driven in one direction only.

No mine should be more carefully forecast than one where the coal is cut off by ravines, along and around which long roadways must be driven, too often only to reach areas which are small and relatively unproductive. When pillars are lost, the tonnage will fail to check with the forecast, and revisions will be necessary. The production of pillars should be compared with the forecast so as to see whether they have been completely removed or with minimum loss. If losses have been sustained, the reason for them should be determined, for loss of coal in pillar drawing is a cause of squeezes as well as of a variation from forecast.

Sometimes spars, bad roof, stained or muddy coal, creep or squeezes may reduce tonnage, and all this should be evaluated, so that development may be speeded if the losses sustained exceed those forecast, or may be slowed if these losses are less than anticipated. In some old mines, squeezes are so frequent that development should be extended much faster than estimates based on complete extraction would indicate, for management should guard against all the conditions it is unable to forecast.

Even with a thick seam, in territory made unfavorable by irregular property lines, outcrops, or seam contours, or by faulting, production hitherto abundantly adequate may suddenly come to an end, because all the convenient coal is exhausted, and future coal must come through a long gangway that has not been developed, the driving of which furnishes, for a while, extremely meager returns.

Tonnageless Development

More perplexing still are the problems when the gangway must be driven in thin coal or in rock. Such gangway troubles make forecasting, even in thick coal with complete extraction, a necessity. Even with a forecast, it is difficult to keep superintendents and foremen dogged in the driving of such an entry, because the reward is so far ahead and tonnage is coming so easily. The entry may be difficult to drain, ventilate and provide with transportation. To the men in charge it appears to be all outgo with no return, and it spoils the cost sheet. But if its driving is essential, that driving must not be delayed beyond the required time, nor started a day sooner than necessary. Excessive entry inventory is just as wasteful of money as stored machinery; in fact, it deteriorates more rapidly and involves much expense. The entry should, however, be started as soon as necessary, so that other entries may be developed from it and so that reliance can be placed on these when the time comes for the abandonment of the worked-out area.

Though the shorter day has not been established in the anthracite region, specific reference should be made to its peculiar management problems. It may, therefore, be added that, where coal is badly folded, two levels, with a difference in elevation of only 50 ft., may be 600 or 700 ft. apart in horizontal distance, whereas two levels with a difference in level of 100 ft. may be only 50 ft. apart in a horizontal plane. In one case, the chambers will be 605 or 704 ft. long respectively and in the other about 112 ft. Such violent variations, however, it must be admitted, rarely occur on adjacent levels.

It is true that these variations in the product per linear foot of gangway interfere with the correctness of a forecast, but erroneous as may be the work of an engineer who cannot correctly forecast contours or pitch, the estimate is sure to be more accurate than the guesses made by those who do not have time or training to make the necessary forecast of what the contours or pitch are likely to be and to estimate their effect on needed development.

Start Should Not Be Premature

Forecasting also determines just when it is necessary to start rock slopes or shafts down to another level, in order to have gangways ready to produce when some other level is losing its daily output. It is as fruitful in preventing premature development as in avoiding a development that is belated. If water tunnels and necessary within-seam connections had been planned and forecast years ago in the anthracite region, drainage costs would have been considerably lower and their benefits enjoyed for many more years than can now be anticipated.

Finally, forecasting also provides for the desired concentration which keeps only a limited area open and yet obtains from it the tonnage for which the plant is designed. It provides for the immediate extraction of heading pillars as soon as they are no longer needed. It endeavors to arrange the best system for keeping a proper relation between operations in seams, though the principles governing such operation are still matters for debate.

Rectification of property lines to avoid such difficulties in operation as have been described, particularly such as will save haulage to both participants, is well worth while. A well-forecast mine map will help in this type of readjustment. To obtain adjustments in territory which will soon be worked, or where haulage, drainage and ventilation problems will be most troublesome, it may be found profitable to make large concessions in remote coal areas.

No matter arouses more difference of opinion than the force necessary to perform day work in various mines and in various subdivisions of the same mine, though usually the conditions are not so greatly divergent as some foremen with an excessive day force would try to believe and assert. In most big mines, and with most big companies, effort is made to bring to some standard the various items of the force employed.

Forces are compared in the various mines and sections and, after discussion, orders are issued as to the number of men of each class to be employed in any mine or section, such orders not to be modified except where special permission is obtained.

In one group of mines, when the number of men needed is being determined for any section, certain active and efficient men are moved into the section under consideration to ascertain what is the least number of men that can perform the required work to keep that section in efficient operating condition. When that is determined, the foreman is required to employ no more than that number, and the expert workmen are shifted to another section.

Costs of mines and sections of mines for all items of operation are plotted in curves and compared with one another, and the costs of one month checked with those of months with equal running time. Supply costs are similarly watched. Thus a running check is kept, and if any costs run high, questions are asked and detailed explanations have to be made. Conditions will vary, it is true, but the knowledge that costs are being compared in detail keeps every superintendent and foreman on his toes.

Cost of each day's ton is now quite closely known every evening. Formerly, costs were ascertained every half month, but the figures often were not definitely known until the close of another week. Consequently, the information was almost three weeks old, and coal was often sold at a loss while the management believed a profit was being made. The foreman would make promises of revision, but it was two weeks before it was known whether he had or had not kept the promises made. Usually, he had some new excuses for the high production cost, and the books continued to be "in the red." With daily estimates of cost, based on the men employed, supplies used and estimated yardage and allowances, a close estimate of the daily cost can be made and charges pared to the bone before any but a day's loss is sustained.

Planning and Knowing How

In earlier days, every man performed his work in his own way. Some work, perhaps, was done too meticulously; more was slighted. Some work cost too much and some was obviously half done. Nowadays, standards are set, and all the work has to accord with such standards, which are evolved as the result of long experience, time studies and conference. With such standards, the quantity of material used is approximately standard, and the workman who has to construct a stopping or overcast, or lay a switch, knows just how much material he will need. He then leaves no material over to be hauled back to stock or to be lost in the mine. He does not have to send out for more material. As he has a blueprint, he knows and can order the material he will need, and can be assured that he has it.

If his job is not properly done, he can be censured, not so much for having failed to do a workmanlike job, regarding which there may be room for disagreement, but on the definite ground that the work is not according to blueprint and directions. Blueprints, schedules and reports usually arouse much dissatisfaction and opposition, but, once established, they soon get to be part of the routine, and often suggestions are made that result in further improvement. When cost-cutting becomes a game, everyone is on his toes to copy the improvements of his colleagues and to adopt their successful methods.

In a big mine, reports are essential. No industry has more natural barriers against inspection than a mine. The manager cannot tell even after a visit just what is going on. The only method of keeping in close and accurate touch is through reports, which should, in the main, be tabulations, the meaning of which can be promptly evaluated. The superintendent and foreman should know early each day how many men are in each section of the mine, how many loading machines are working and how many places have been cut. Fallen places, standing gas and blocks on the tracks also should find a place in the report.

Time Studies Tell the Tale

Time studies are invaluable, as they show just what changes are needed to effect economy. A condition may seem unusual and adventitious, but, if it appears frequently on the time chart as the cause of delay, it needs investigation. Some losses of time are almost inevitable, but many are, at least in part, the result of misdirection. Losses of time, when broken down into causes, clamor for attention. Most of them are defects of management, not of the workmen. If the employee understood this matter, he would be less critical of time studies.

Slowness in performance of many functions is due to lack of power, lack of material, material of the wrong sort, or the furnishing of timber for hand cutting where machine-cut timber would be more effective. Loss of time arises from uncoordinated haulage, cars too small for best results, inconvenient switching points and bad gradients.

However, tracks badly laid by the employee, falls due to improper timbering, undislodged coal due to inadequate shooting, and delays in drilling due to improperly sharpened tools are chargeable to the employee. Only by having delays set forth, one by one, and their time loss evaluated, can a careful study be made of the various operations. Then, after each important revision, the time study should be repeated to ascertain what improvement, if any, has been made.

Cost studies also are necessary. Managers should know not only cost per ton of coal but cost per unit of work, per mile of track laid, per mile of track maintained, per cubic foot of excavation, per yard of ditch dug, per switch laid, per stopping or overcast erected, per overcast shot, per bond installed, per hanger placed, per 100 ft. of wire erected, and so forth. These cost studies should be made up into book form for ready reference, and superintendents and foremen should have the information always available. When such studies are made, thought is inevitably given to means whereby such costs may be reduced.

Standardization will result in smaller inventories. By carefully assessing in detail the quantities required for operation, supplies kept in storage can be made on an average not to exceed the requirements for two months' operation. Reduced inventory often will provide the management with capital to expend on needed machinery for more economical operation.

A new mind freed from old predilections and practices and ready to view the mine as an outsider, critical, observant and questioning—the attitude of the consulting engineer—is needed at most mines. Particularly do mines where pillars are not removed need a new viewpoint; to get it, cost of development, including grading, cost of tracklaying, rail, bonding, wiring, timbering, telephone wiring, ventilation, drainage and the like, should be added and the sum divided by the tons mined in the same period and then by the tons that would have been mined had both pillars and rooms been extracted.

Then if that does not sufficiently convince, consider the postponing of high-cost production due to the fact that the mine, not aging as rapidly as it has done in the past, will have transportation, ventilation, drainage, rail, piping, wiring, bonding and other costs raised less rapidly. Substations will remain longer in one place because of the greater tonnage accessible from a single point.

Pillar Losses Double Costs

Of all economies, "savings" due to the leaving of pillars are the most dubious, but, if the pillars are to be recovered, methods for breaking the roof along long breaklines must be adopted, such as are used in mines where extraction is complete. Only the checkerboard system seems to justify in any degree the leaving of room pillars, and even that system should be subjected to careful inquiry. In withdrawing pillars, shaking conveyors could be used if conditions did not favor mobile loaders. By leaving pillars unmined, the investment cost of the surface plant per ton of product is increased 100 per cent—that is, if it was 5c. with complete extraction, it would be 10c. with 50 per cent extraction.

MECHANIZATION

+ Becomes a Keener Cost-Cutting Weapon

COAL OPERATORS for many years have been faced with the problem of reducing costs to hold markets. The action of the bituminous industry in granting higher rates and shorter hours to the miners throws this important problem into even sharper relief and increases the intensity of the drive for reduced costs through higher output per man. Lost motion is an accompaniment of every human activity, and mining, most of all, has suffered from this disadvantage. To produce cheap coal, mass-production methods must be approached as closely as possible, which means:

1. Concentration.
2. Continuity and simplicity.
3. Routing and timing.
4. Elimination of subsidiary operations.

Tonnage or Territory?

Concentration is necessary because the cost of adequate service, maintenance and supervision is excessive where the work is divided among a number of units scattered over a wide area. Transportation, power supply, ventilation, drainage, supplies and materials, rock-dusting, lighting and other services can be more efficiently handled in bulk at one point rather than in small quantities over a large territory. Consequently, the cost of supplying them is less and, in addition, the open area to be maintained is reduced, the efficiency of haulage units and similar equipment is increased through reduction of distance between places, and supervision, being concentrated, will produce better results, all of which are reflected in a better opportunity for the loader, whether a man or a machine, with consequent improvement in output.

Nova Scotia offers an example of the possibilities of concentration when carried out to the logical limit. Operation is by longwall, a single working place furnishing a daily output of 750 tons. Were the same tonnage mined by hand from rooms, assuming a daily man-average of 5 tons, which may not be excessive where the coal is thin, 150 working places would be required and at least five times as many entries. Assuming an average room length of 150 ft., over 4 miles of track, or 8 miles of rail, 150 room switches and 7,040 room ties would be necessary. While one foreman could supervise the 750-ton face without difficulty, he would have to walk many miles to supervise the work of the 150 loaders and even then would be able to give only passing attention to conditions in each place.

Attack the Major Item—Mining

New wage schedules and shorter hours in the bituminous industry throw simplification and concentration of mining operations even more sharply into the spotlight than in the past. Trimming away effort on "magnificent distances" is a costly luxury, for mines are measured by tonnage, not by number of employees, miles of track or equipment inventories.

How to pay higher wages and yet reduce costs and how to work shorter hours and yet produce the same tonnage are the questions of the hour. The complete solution almost inevitably turns on the mechanization of loading, either wholly or in part, as conditions may warrant. Substituting machines for human effort removes at one stroke the major handicap of man's physical limitations and clears the way to an all-round increase in efficiency, accompanied by a corresponding cut in cost—the most potent weapon in the war against other fuels.

As a matter of fact, five bosses would not be excessive for 150 men, and some would say seven. Other services would be subject to similar limitations.

Where the coal is thick, the average output per man frequently is several times the 5 tons mentioned above, and the problem of obtaining concentration is not so difficult. Even in thin seams, however, careful consideration of the problem will reveal opportunities for concentration, and if, in addition, more and larger cars are promptly furnished, track is kept up to prevent derailments, room driving is systematized in connection with sights and proper instructions to the miner, ventilation improved, water removed promptly and posts and caps are furnished as needed, a substantial increase in output generally will follow.

For a given daily tonnage, however, the degree of concentration possible with hand-loading is limited by the physical capacity of the miner, as represented by the tonnage he can load when working steadily for a full shift. Transfer of drilling, blasting, timbering, tracklaying and similar activities to the day force will allow a certain increase in the maximum output of the loader in addition to the other benefits which may accrue through the performance of these service activities by trained men—equipped, where necessary, with specialized machinery. Nevertheless, the above measures may not provide the complete answer to the present-day questions of (1) How to pay more wages and keep down cost? and (2) How to work shorter time and yet produce as much coal as before? Where this is the case, mechanization of loading offers the way out. Such mechanization is particularly helpful where high wage rates prevail, which is generally the case today.

Mechanization Offers?

Mechanization of loading may take a number of forms, varying largely in the extent to which human effort is replaced by machinery. Mobile loaders, self-loading shaker conveyors and scrapers are examples of complete or practically complete transfer of loading to machines, while pit-car loaders function largely by relieving the miner of the task of lifting coal from the bottom to the top of the car. The same applies to conveyors (with the exception noted above), although this type of equipment takes over a part of the task of the transportation system.

With the exception of mobile loaders and pit-car loaders, which are limited

by their physical characteristics to fairly thick coal, all the above types of equipment can be used interchangeably. Experience, however, has in general assigned each type to a particular field. Mobile loaders, which are designed for high tonnage, are confined to thicker coal, though the lower limit is being reduced year by year by improvements in design. The thick-coal rule does not always hold true, however, as the mobile loader occasionally is used in thin coal where it is necessary to take down drawslate or loose top regardless of the mining system used. Pit-car loaders also are limited to the thicker seams by reason of their design.

Conveyors and scrapers may be used successfully in either thick or thin coal, but generally are confined to the latter, where their greatest advantage is the elimination of the rock work that would be required to allow cars to go to the working face. Conveyors in particular, and also scrapers, frequently are employed in driving headings, not only in thin coal, where that type of equipment is used throughout, but also in mines employing mobile loaders. In the latter case, limited tonnage and frequent moving from place to place may make it unprofitable to use a high-tonnage machine that could be giving better service elsewhere for entry-driving. In thin coal, conveyors—also scrapers—make it possible to remove from two to four cuts per day, including handling the necessary rock that must be removed to secure height for cars, thus easing the problem of securing adequate development. In fact, machines, including the special types developed primarily for this purpose, may be of advantage under any kind of mining system if developing entries fast enough to keep up production is a difficult problem with the methods usually employed. Pit-car loaders, generally strengthened for the service, also have been found beneficial in entry-driving where rock must be handled. Anthracite companies have set the pace in this particular activity.

A New Viewpoint Necessary

Mechanization of loading, in addition to changes in mining and service activities, also requires a different attitude on the part of management. Mechanical-loading equipment requires a definite cash outlay, and the machines, being inanimate, cannot of themselves work in the most efficient manner. Consequently, it is up to management to insure proper working conditions, and one of the first steps in this direction is a sympathetic attitude on the part of operating officials directly responsible for the performance of the equipment. Hostility, indifference and a mind closed to new ideas are major hurdles which may break a mechanization program, particularly if they are reflected in or reinforce antagonism among the rank and file. Where these sentiments are a possible source of trouble it is first necessary to "sell" the program or, if that fails, to put men in charge that are friendly to it.

Introduction of mechanical-loading equipment into a mine or a field for the first time brings up the serious problem of an adequate supply of skilled labor. Even old, experienced mechanical-loading crews need careful supervision and energetic leadership, and consequently the training problem should receive serious consideration. Immediate transfer of a whole mine from hand- to mechanical-loading may be an unwise move for that reason. Gradual replacement of hand-work with machines would seem

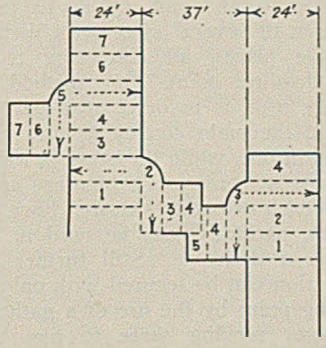


Fig. 1—Checkerboard System Promotes Concentration

to be the better method in most cases. In this way, crews may be trained as each machine is introduced, or the initial machine may be used in training a number; also cutting, drilling, blasting, haulage, supervision and other auxiliary activities could be worked out in advance of complete mechanization, thus smoothing the introduction of succeeding units. Machine-crew personnel also is an important factor in the success of mechanical loading. Progressiveness and adaptability are prime requisites, as is a congenial spirit within a single crew. The latter, if not checked by arbitrary restrictions enforced by management, usually will evolve from a process of natural selection working among the employees.

Because of their inherently high loading rate, delays are reflected in a material decrease in tonnage where mobile loaders are used. Consequently, unusually careful coordination of mining development, machine operation and service activities is essential for maximum efficiency. Accordingly, the system finally adopted should take into consideration the following factors: a development plan that will cut travel between places to a minimum and also produce a maximum quantity of coal per face; face-preparation methods that will reduce digging and clean-up activities as far as possible while yielding the largest possible percentage of coarse coal; car-changing methods that will allow the machine to approach as closely as possible continuous loading; a scheduling system that will eliminate interference from auxiliary activities; and an inspection and maintenance system that will eliminate delays due to breakdowns.

Though longwall offers the greatest possibilities from the standpoint of production per place, the problems of roof control, particularly in the light of the necessarily wide roadway which must be kept open to allow the loader, cars and other equipment to operate along the face, may overbalance the benefits that otherwise would accrue with this system. Consequently, room systems similar to those employed in hand-loading have persisted, with modifications to facilitate loader operation. Where the roof tends to be weak, however, the quantity of coal which can be obtained from any one place necessarily is small, due to the limitations on the length of the face. As a result, time is lost in traveling from place to place. To avoid this penalty on production, the "checkerboard" system has been developed to increase the tonnage per place without unduly increasing the width (Fig. 1). Crosscuts are driven from adjacent rooms, so that coal from each side can be reached by the machine and loaded directly into the mine cars. The crosscuts are staggered so that the inbye edges of a crosscut on the right will be opposite the outbye edge of the crosscut on the left. As the crosscuts are driven 15 ft. wide, staggering them reduces the danger that would result if wide spaces were left in the pillars.

With this system and rooms 24 ft. wide, a kerf can be cut in the face and curved round toward the right or left pillar, giving a 39-ft. face for shooting and loading. The next cut in the room would be narrow, but a cut could be made in the crosscut at the same time, giving an equal tonnage on this advance, even though the face is not continuous. The next room cut, however, affords an opportunity for a swinging cut, this time toward the opposite side of the room. This system generally yields a large tonnage at low cost.

Machine Must Have a Chance

Face-preparation and car-changing considerations in mechanical loading are discussed in articles beginning on pp. 165 and 167 of this issue, respectively. Long experience with mobile loading equipment may minimize the need for a definite scheduling system, but does not entirely eliminate it. Scheduling should start with the beginning of the shift and continue throughout the day, in order that each piece of equipment and each operating and service crew may proceed according to a definite plan and thus avoid interfering with each other. Making up the schedule for the shift is properly the task of the section or unit foreman, who also should keep track of the delays and the reason therefor as the basis for a daily report. Good maintenance practice generally demands the

employment of one repairman for one or two units, and also the purchase of spare units of major equipment which can be rushed in in case of a serious breakdown or accident.

Where coal is too low for mobile loaders, conveyors and scrapers apply, although, as pointed out above, they are not limited to thin seams. Rolls or a soft floor, however, may militate against the use of scrapers, which would tend to plow the bottom into the coal. Shaking conveyors are designed to lift coal up slight gradients, but any increase in the adverse inclination reduces capacity. Consequently they do their best work on the level or on a gradient favoring the coal. Where adverse gradients are frequent, they have led to the adoption of the chain-and-flight or belt conveyor, which, within limits, is not affected by an unfavorable pitch. Belt conveyors, where the adverse pitch of the place is not too great, also provide a positive flow of coal which is little affected by the gradient. In considering the question of gradients, it should be remembered that if the car rests on the bottom of the seam, the discharge end of the conveyor, in the absence of special provisions, must be raised in order to get the coal into the car. This puts a strain on the drive and limits capacity. Consequently, where the bottom has not been lifted, elevators and pit-car loaders may be found helpful.

Opening Up With Longwall

Like mobile loaders, conveyors quite frequently are used with development plans similar to those employed in hand loading. Conveyors, however, are one of the types of equipment particularly suited to longwall work, due to the fact that less open space is required in front of the face and it therefore can be protected more adequately. Usual practice in longwall work with conveyors is based on keeping haulageways in solid coal, the face conveyors feeding to secondary conveyors extending a suitable distance back to a crosscut in the entry pillar, where they discharge onto a crosscut conveyor for final delivery of the coal to the cars on the haulage heading.

Double-tracking is customary in wide rooms in hand-loading to avoid throwing coal long distances. In conveyor mining in wide rooms or chambers, the use of the short mat-type or chain-and-flight face conveyor eliminates the problem of pitching coal by hand and thereby increases efficiency. This conveyor is laid across the face and delivers to the main room conveyor. Quite frequently, where the face unit is sufficiently strong, it may be moved up and the coal shot down on it, thus eliminating in some cases all but about one-third of the usual shoveling. Where shaking conveyors are employed, it is possible by the use of a bell crank and ropes to employ a shaking face conveyor which reciprocates in unison with the main room conveyor. This face conveyor can be equipped with a self-loading head, or duckbill. With this type of equipment, wide rooms are provided and the face is worked by the offset method. That is, an offset is made at one end of the face near the main conveyor, and then is extended across the face by as many cutting, shooting and loading cycles as may be necessary.

More Tonnage—One Loading Point

Unless two tracks are provided in the heading, only one loading point is possible on an entry. This makes it desirable to increase the quantity of coal delivered to this point and has led to the adoption of several systems of working multiple places, all delivering to the same loading point. One method frequently used is to drive two places as a unit, the main conveying unit being placed in one, while the other is worked by crosscut conveyors which are moved up as each crosscut is made. Face conveyors, naturally, can be used in both places, if desirable. Still further concentration can be secured with only one loading point by the use of a gathering conveyor serving three to five room units. The gathering conveyor is installed in the heading parallel to the haulageway, and discharges onto a cross conveyor which delivers the coal through the entry pillar to the cars. Various modifications of the above system can be worked out to suit individual conditions.

Where the coal is thin, lifting the bottom frequently is necessary if cars are to be brought to the conveyor loading points. To eliminate the cost of the necessary rock work and also increase the number of conveying units working on a single entry to a maximum, several companies have adopted the gathering belt. With this equipment, two parallel headings are driven—usually not over 1,200 ft.—the belt being extended as the headings are advanced, shaking or chain-and-flight conveyors—whichever are used in developing the rooms or chambers—usually being employed for the actual driving operation. Rooms are turned and driven and the pillars are removed down to the entry stumps by conveyors feeding onto the gathering conveyor on one heading on the advance and on the other heading on the retreat, the retreat work also taking in the stumps and chain pillars for complete extraction. If gradients or other conditions prevent turning rooms from both headings, work can be confined to one, although in this case the quantity of coal produced per gathering-belt set-up will be reduced. Cars are loaded in trips at the mouth of the entry, sidetracks being provided or track being laid through a crosscut into the heading paralleling the belt heading.

Conveyors also are particularly adaptable to the extraction of pillars in crushed territories. Through their use, skipping, or driving a narrow passageway up the side of the pillar as a preliminary to complete extraction, is facilitated, thus avoiding the expense of timbering and handling fallen material which otherwise would be required in recovery.

Scrapers should not be required to travel long distances, as this reduces the time actually spent in loading and discharging. Like conveyors, this equipment is used with both room-and-pillar and longwall systems, and the same general considerations apply. In addition to the other general plans of mining, slabbing methods have been adopted by some companies and yield large tonnages. With this system, rooms are driven and then one of the pillars is cut for its full length and shot in sections, the coal being taken to the loading point on the heading by a scraper—usually large—so attached to the rope that it pulls into the coal along the shattered face. Such scrapers will take 4 or 5 tons per trip. Large pillars have to be left at intervals, however, and roof control sometimes is difficult. Only two places are driven on an entry, one in the advancing stage and the other in the slabbing stage.

What Price Complete Extraction?

Value of coal in the ground often is the least of two reasons for complete extraction. The other is the cost of leaving the coal in regardless of its value, which arises from lost service from mine plants, shafts, slopes, drifts, headings, crosscuts, rails, grading, bonds, ties, switches, drainage—in short, from almost every item of equipment. It is as if a railroad had laid two tracks and used only one. Complete extraction decreases the facilities which have to be provided for a given total tonnage and therefore, where not prohibited by other considerations, offers major possibilities for savings. One major reason for incomplete extraction is restrictions governing surface support, and where this is the case backfilling may offer the way out.

When the roof is strong and heavy, complete extraction demands that the workings be suitably laid out for complete pillar recovery, which means that break lines must be carefully planned and of adequate length. To save trouble, roof breaks, once obtained, must be husbanded as carefully as the ancients nursed their fires. A good first break may be worth thousands of dollars to a mining company, as the subsequent breaks usually will follow along in sequence at the proper time if break lines are kept straight and enough width is provided. It quite frequently is contended that a break line can be obtained satisfactorily in the area opened up by each room entry, which is entirely pos-

(Turn to page 166)

FACE PREPARATION

+ Opens New Vistas for Modernization

CUTTING, drilling and blasting constitute what generally is termed "face preparation." Cutting, with a few exceptions, traditionally has been a company activity performed by specialized employees. Drilling and blasting, however, originally were considered to be a part of the loader's task, but an increasing consciousness of the importance of their effect on loader efficiency and on character of product has favored the transfer of one or both of these activities to the company list.

Although drilling and blasting by the miner is not directly shown in the cost sheet, it nevertheless is present in the tonnage rate. Transfer of these activities to the company, therefore, is worthy of consideration for the following reasons: increased output per loader, due to better condition of the cut after blasting and elimination of the time spent in drilling and blasting; decreased cost, as expenditures for these activities when carried on by trained men with specialized equipment quite frequently will be less than the differential allowed for the work; higher average realization per ton, because less fines will be formed when heavy blasting and other detrimental practices are prevented; and greater safety. Even where drilling and blasting are left in the hands of the loader, it is possible by a study of conditions, establishment of standard practices and adequate supervision to obtain larger coal and increase safety.

The primary purpose of cutting a face is to free an additional side of the block of coal to be removed. In addition to the safety aspects, cutting therefore reduces the quantity of explosives required and likewise the percentage of fines in the broken-down coal. Undercutting by shortwall machines still is the method most generally employed. Other types of equipment used for the same purpose include longwall, breast and punching machines. The supremacy of the bottom-cutting machine has been challenged in late years, however, by the track-mounted machine, which has been growing in popularity where mining conditions, particularly sufficient seam thickness, permit its use.

Higher tonnage per machine and ability, within limits and depending on the design of the machine, to cut at any level from the top to the bottom of the seam, are the two major factors which have led many operators to adopt track-mounted equipment. By elimination of time spent in loading and unloading machines which operate on the bottom, the average output per machine is doubled or tripled, as a rule, when a change is made to track-mounted equipment. Under certain conditions, however, tonnage may not be the controlling factor, particularly where cutting at some other level than at the bottom may be employed to reduce the cost of removing bedded impurities. With track-mounted machines, it is possible, depending upon conditions, to cut in the impurity band (or bands), as well as under or over the impurity. This may be followed, in the latter two instances, by a raking cut or cuts at high speed or by shooting to break up the impurities followed by a raking cut to pull them out of the kerf, after which they may be loaded or gobbed. Even where impurities are not the major problem, the possibility of changing from a hard to a soft streak in placing the cut may be worth while as a means of increasing machine output and reducing wear and tear. Coarser cuttings is another possibility with track-mounted cutters, due to the generally faster feed.

Increasing the output of cutting machines, a vital factor in the light of code developments, largely is dependent on the elimination of idle or non-productive time. Concentration of working places to reduce the distance traveled, a major factor in haulage, applies with equal force in cutting; also good track and the maintenance of the proper voltage at the machine. Bits and bit-changing, due to their influence on the character of the cutting and the time required in this operation, are important factors in cutter operation. Establishment of definite standards governing "dullness" and setting of the bits in the blocks, selection of the shape best adapted to conditions and study of the possibilities of various types of alloy steels and hard-surfacing materials may result in a substantial increase in machine output, together with a decrease in the cost of bit material and sharpening labor. Experience at several operations using either alloy steels alone or in combination with hard-surfacing has shown that the tonnage cut per bit may be increased from three to twelve times.

Blasting is essentially a means of reducing the solid coal to a size and state which will allow it to be handled by the loader, whether hand or machine. As coarse coal commands the best price, blasting methods must be based on the production of a maximum percentage of the larger sizes without the presence of chunks which must be further reduced by hand. The latter, however, is sub-

No Standing

Standing cuts have no standing in coal mining. Disheartening as they may be to a hand loader, they may be a minor tragedy where a high-tonnage mobile loader is operating, especially where they occur with relative frequency. But in addition to making the task of the loader easier, face-preparation methods must yield a maximum percentage of coarse coal and meet the same efficiency requirements as other mining operations. Improvement programs, therefore, may take in a part or all of the following:

Transfer of drilling and blasting to the company list, if not already the practice.

Study of track-mounted cutters, where applicable, as a means of increasing production per machine or facilitating removal of bedded impurities.

Concentration of working places, good track, proper voltage and new bit materials and improved bit-changing practices to increase cutting-machine output and improve character of product.

Examination of blasting practices and agents to determine their efficiency as of themselves and in relation to cutting and drilling practice.

Study of the possibilites of modern post-mounted, cutter-mounted and track-mounted drills, as well as late developments in auger and bit materials and design.

ject to exception, as a few operators prefer to load the coal in as large pieces as possible and break it up with air hammers on the tipple. Even where the coarse sizes are crushed, the need for careful blasting should not be overlooked, as heavy shooting may weaken the lumps and cause an excessive reduction in the crushing process. Disintegration of apparently solid lumps during screening, handling and shipment, particularly the latter, also calls for lighter shooting.

What Influences Blasting?

Major factors influencing blasting results, in addition to the character of the coal itself, include: number of free faces; number of and location of drillholes; nature, number and thickness of impurity bands or partings; character and quantity of explosives used; charging methods employed; and loading system in use. Increasing the number of free faces usually means a shearing cut in addition to the horizontal cut where physical conditions and thickness of the seam permit. Shearing increases the quantity of cuttings, a serious factor where the coal is thin, but in thick coal this may be more than balanced by a higher output of coarse coal primarily as a result of lighter shooting. Number and location of drillholes must be determined in the light of local conditions, but studies undertaken as a basis for improvement might well consider the possibility of increasing the number of holes, thus decreasing the quantity of explosives per charge and thereby the pulverizing force exerted. This should increase the output of coarse sizes and also prevent excessive degradation of impurities, thus facilitating their removal at the face.

As a means of breaking down coal, the operator bent on obtaining maximum results today has a wide choice between explosives proper, blasting agents or systems based on the sudden expansion of air or gases and, lately, mechanical devices operating on the expansion principle. With the exception of mechanical expansion equipment, the various blasting agents and explosives require maximum confinement until they have done their work. Hence, tamping and stemming methods should be carefully developed, not only to increase efficiency but also to promote safety. In certain cases also the cut must be blocked up to prevent the formation of cracks which would allow the gases to escape. In addition, particularly where the coal is undercut, the mass should be free to fall as far as possible in order that the shock may aid the explosive or other blasting agent in breaking up the coal. Consequently, kerfs should be cleaned thoroughly before shooting. Snubbing also may increase the free fall, and where properly done may aid in rolling the coal out from the back of the cut.

Mechanical loading presents blasting problems of its own, with the exception of conveyor mining, which is similar to hand-loading, except that the conveyor, in general, partially replaces the mine car as transporting medium and shoveling height is reduced. When mechanical loaders, however, dig in standing coal the loading rate is slowed down and more power is consumed. Consequently, blasting methods should, as far as possible, roll the cut over or throw the coal out a short distance from the face (snubbing may materially assist this action), and heavier shooting may be required to make sure that the coal is sufficiently broken up for easy handling. Overhangs and standing sections requiring pop shots or heavy pick work must be eliminated. Where small scrapers are employed, the limitations in digging power impose the same burdens on blasting methods as with mobile loaders, but to a greater degree.

With hand loading, it is still customary, as indicated above, to leave drilling in the hands of the loader, but in late years, a distinct trend toward mechanization of this activity has developed. Even where drilling by the loaders is continued, a number of companies have found it worth while to supply portable electric or air equipment to the miner, thus lightening the drilling burden and enabling the loader to devote more time to his primary task. Better drilling results than usually can be obtained with hand equipment are another factor.

Will Hand Drilling Do?

Although better results usually have been obtained when loaders have been supplied with portable power-operated equipment, the possibility of a still greater increase in efficiency and a further reduction in cost has led in a number of instances to complete mechanization of drilling activities by the use of company-operated post-mounted drills, drills mounted on cutting machines and track-mounted drilling machines. The last are, in general, comparatively recent developments. Although mounting drills on cutting machines reduces the time required to get them in action, it also reduces the time that can be devoted to cutting activities, and for that reason a number of operators have turned to track-mounted types equipped with either one or two spindles. Latest types of drilling equipment, in addition to their other advantages also facilitate the drilling of horizontal holes near the top or bottom, usually impracticable with hand methods. It is generally accepted that horizontal holes yield best results both from the standpoint of blasting itself and the protection of the roof, except in certain cases where it may be necessary to break up partings or meet other special conditions.

Revision of auger and bit practice in late years has turned on the selection of tough alloy steels to decrease breakage and lengthen the life of cutting edges; the use of shankless augers to reduce the labor required in forming shanks; the adoption of detachable bits for both augers and pneumatic drill steel to decrease not only the expense of transporting steel back and forth for sharpening but also cost of material; and the use of hard-surfacing materials on auger bits as a means of prolonging the average life of cutting edges and also of increasing drilling speed, due to the fact that the bits stay sharp longer.

MECHANIZATION
A Cost-Cutting Weapon

(Concluded from page 164)

sible where the roof is weak and the cover is thin. But with a strong roof and deep coal, the development plan should provide for a long break line extending over several entries if necessary. The work, however, should not stop there, as driving rooms and pulling pillars in accordance with a definite plan is equally important if the break line that is the lifeline of the mine is to be maintained and weight kept off live working sections. Leaving pillars or stumps to form islands of coal in the gob should be scrupulously avoided, as they may prevent the roof from breaking, with the result that the weight rides over onto the working sections even if a squeeze or crush does not result. In extreme cases, drillholes might be sunk from the surface on the natural draw lines over the coal pillars, where the rock normally would break, and shot with heavy charges to obtain an initial roof break with the least damage to the coal face.

Excess heading inventory is as much a cause of high cost as excess machine inventory. Moreover, machines are less expensive on inventory than headings, as they need no attention beyond shelter and a little grease, while headings must be ventilated and maintained even when idle. While it is true that machines may become obsolete, the parallel does not fall in the case of headings, which heave and cave and need timbering. For this reason, it rarely pays to drive to distant boundaries and work back, despite the advantages of operation on the retreat. With special entry-driving equipment, the cost of reaching such boundaries is reduced, but it is still a cost that should be avoided as a general rule if low costs are to be secured. However, there is an argument in favor of retreat by panels, because the roof can then be broken at a considerable distance from the entries, so that the resulting crush will affect little besides the pillars being extracted instead of weakening and demolishing both pillars and entries.

TRANSPORTATION

+ Clears the Way to Higher Efficiency

NEXT to loading, transportation is the largest item in operating cost at bituminous mines. Though this is not always true at anthracite operations, where preparation expenditures quite often replace it in second position, the cost of transporting coal nevertheless is an important item. In addition to being a vital activity of its own right, transportation also may influence materially the efficiencies of other departments of operation. This influence is particularly noticeable in loading, both hand and mechanical, not only in the output of the loaders but also in the past course of hand-loading rates, a substantial portion of the pressure for increases in these rates being due directly to inefficient service—transportation in particular—which was directly reflected in a "poor turn."

Though increases in loading rates due to poor turn have been one of the outstanding results of inadequate transportation, which does not necessarily mean lack of equipment, other adverse effects may, in the aggregate, substantially handicap operations by making it difficult to produce the required tonnage. With the advent of the seven-hour day in the bituminous industry, making a one-seventh increase in operating rate mandatory if the same tonnage is to be produced per day, further extension of transportation improvements made in recent years becomes imperative.

If not already a fact so commonly accepted as to bar argument, actual experience at a number of operations where improvement programs have been attempted leads to the conclusion that the hand loader, in general, could work at a considerably increased rate if he were afforded a full opportunity to do so, and that therefore the problem of manpower frequently can be solved by insuring the man at the face an adequate car supply. With mechanical loading, particularly where large-tonnage mobile loaders are employed, the large direct investment in equipment has necessarily focussed attention on the reduction of non-productive time. Consequently, installation of machines in almost all cases has been accompanied by the adoption of methods for reducing car-changing time which might equally well be applied in hand-loading.

Transportation approaches the ideal state when, except for the time actually required for loading and dumping, cars are continuously in motion at the maximum speed compatible with safety and efficiency over the shortest route between the loading and dumping points. Shortest route does not necessarily mean a straight line between loading and dumping points, though such a possibility should by no means be dismissed as impractical in all cases, but rather that unnecessary back-tracking and excessive hauls should be eliminated. With this definition in mind, the major factors affecting transportation results may be enumerated as (1) car capacity in use and (2) distribution. The latter, of course, includes the following considerations: (*a*) gathering, secondary and main-haulage equipment and methods, including track layout and the car-changing and handling systems thereby established; (*b*) control and scheduling of equipment movements; (*c*) track; and (*d*) power supply.

Transportation inefficiencies may occur at any point between the surface plant and the face, and the first step in an improvement program naturally is an investigation to discover just where the hitches occur. Such investigation should rely largely on time studies of the various operations entering into, affecting or affected by transportation. While time studies are likely to be regarded with considerable trepidation, because of the air of abstruse scientific calculation with which they have at times been surrounded, the process of making such a study and interpreting the data is in reality relatively simple. The necessary data for a study of main haulage, for example, can be gathered by the locomotive runner, or runners, with the assistance of a dollar watch and a pad of paper, the process consisting essentially of recording the time when a particular period of activity or inactivity begins and ends. A complete record for a shift will then show just how much time was spent in both productive and non-productive work.

Interpretation of the data also is relatively simple when conditions are known. Starting at the shaft bottom, for instance, and disregarding for the moment the possibility of a scarcity of cars, the presence of locomotives habitually waiting for trips to be made up would indicate, in general, that the hoist is delaying the transportation sytem. Assuming adequate hoist capacity, haulage locomotives working at capacity during the day while gathering units report waiting periods would indicate, in the absence of modifying factors, insufficient main or secondary haulage capacity (not enough locomotives, excessive hauls, etc.). Gathering units working at capacity while loaders spend long periods in waiting for cars may well mean that the units are serving too many men or that haulage distances are excessive due to lack of concentration, long hauls to partings or car-changing

Quiz Time

Transportation, along with other mining activities, is now called upon to pass the stiffest test in history. A passing mark will depend upon its ability to meet satisfactorily most or all of the following requirements:

1. Elimination of excess gathering travel (concentration, changing cars close to the face).
2. Shortest possible hauls to sidetracks.
3. Maintenance of proper voltage.
4. Coordination of operation as between main, secondary and gathering units and other mine activities (dispatching).
5. Shortest possible main and secondary hauls.
6. Well-built tracks sufficiently heavy for the service they are required to meet.
7. Sufficient well-designed mine cars with the largest possible individual capacity.

arrangements that cause unnecessary locomotive travel. A situation where all units from the face to the surface plant habitually report waiting periods may be taken, in the absence of other factors, to indicate a car shortage.

As performance of one part of the transportation system inevitably reacts on all other activities back to the face, bottle necks should be attacked first. These will be shown by the time studies, and their elimination will, of course, offer immediate relief, though not in many cases to the full extent that might be possible, for the removal of one obstruction may create another at some other point. This leads to the conclusion that work on one part of the transportation system necessarily develops into a study of all the activities at the mine, the objective being maximum coordination throughout so that each element will perform at the most efficient rate without delaying the others.

Of the several measures which may be adopted to increase transportation efficiency, one of the most important from the standpoint of possible results, yet requiring the least outlay for equipment or labor, is reducing the length of the gathering haul. One of the best methods of accomplishing this is grouping the maximum number of working places in a given area or increasing the production per working place, commonly termed concentration. Another equally important method is reducing the distance traveled in changing a single car, while a third is based on decreasing the haul to the sidetrack.

Which—Mileage or Tonnage?

Boiled down to essentials, reducing the length of haul means that the haulage unit can serve more loaders or serve an equal number better. The result, naturally, is a higher production per section growing out of either the increased number of loaders or the higher production per man and per place. Also, it may be possible to reduce the number of gathering units and crews, or, equally important, that better distribution of cars may make is unnecessary to purchase additional equipment to maintain or increase production.

In general, it seems evident that mining methods should be adjusted so that the major part of a gathering unit's activity will be confined to a single room entry, though clean-up work in the entry behind or development in the place ahead may require that two or three entries be served by a single unit. Where conditions are favorable, travel up and down entries can be reduced by establishing auxiliary haulways through rooms from one entry to another.

Where car-changing practice is based on pulling the car from the face to the entry, the distance traveled in this operation may mount up to a susbtantial total in a single shift. This practice is illustrated graphically in Fig. 1, which

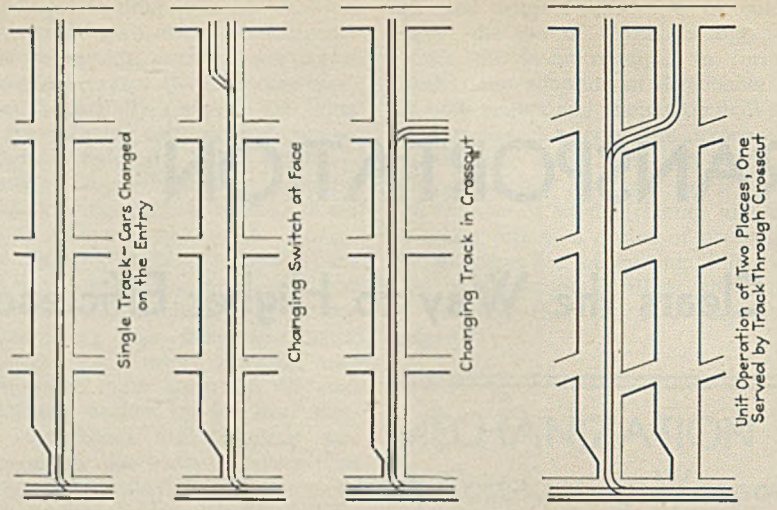


Fig. 1—Changing Facilities Close to the Face Reduce Gathering Time

also shows two general methods of reducing travel in car changing by the use of switches at the face or crosscut tracks. A switch at the face, where the place is wide enough to permit its installation, gives an extra track for car changing, and also may reduce the problem of pitching coal from far corners to the car. The maximum benefit from such a system will be lost, however, unless the switch or, in the case of the alternate system, the crosscut track, is moved forward regularly. This may require extra labor, although there are now available several types of portable switches which can be placed in approximately two hours and also one or two special switches which make breaking the track for installation unnecessary. When, for example, it is considered that a gathering unit serving ten places averaging 160 ft. deep and gathering 60 loaded cars per shift will travel nearly 3 miles further in changing on the entry rather than at a point 30 ft. (on an average) behind the face, the benefits of keeping up changing points may be appreciated. At an average speed of 4 m.p.h., not generally exceeded in room travel, even when high-speed equipment is used, the time loss per shift would be 45 minutes. In some cases it will be much higher. The above analysis gives force to the observation that a gathering locomotive that is constantly on the job may not necessarily be producing all that it could.

Long hauls to sidetracks also frequently cause lost time. At an average speed of 4 m.p.h., each 1,000 ft. of extra travel would require 3 minutes, or 6 minutes for the round trip. At 6 m.p.h., the time required is 2 minutes per 1,000 ft. Six round trips to the parting per shift at 4 m.p.h. would involve a time loss of 36 minutes per 1,000 ft. of excess travel; 10 trips, 60 minutes. Consequently, it is important that sidetracks be kept close to the working sections. In general, maximum haul should not exceed 2,000 ft., and at least one company has standardized on 1,800 ft.

Voltage conditions, in addition to their effect on maintenance, also may play an important part in both gathering- and haulage-locomotive performance. If, for example, the average speed of a gathering locomotive at rated voltage is assumed to be 2.5 m.p.h., including idle time, a reduction to 2.25 m.p.h., or 10 per cent, due to voltage drop (or other causes, as well) would decrease the distance traveled in seven hours of working time by 1.75 miles, or 9,240 ft., equivalent to 29 car changes averaging 160 ft. per change. The logical remedies for poor voltage are, of course, increased feeder capacity, better returns and relocation of substations.

Keeping Step With Mobile Loaders

Where mobile loaders have been installed, the importance of keeping them actually loading as much of the time as possible has resulted, in general, in ready acceptance of the principle that car-changing delays must be eliminated as far as possible. Consequently, practically all mining plans designed around mobile loaders, whether one or two haulage units are used, provide either for a separate track at the face on which an empty car can be left for loading while the locomotive is changing the load (the usual system where only one haulage unit is employed) or for the establishment of passing points as close to the face as possible where two changing units are employed. In the latter case, the methods correspond to those outlined above—namely, the use of switches to give two tracks at the face or the establishment of a passing track in the nearest crosscut. The two-unit system of gathering is preferred by a number of operators because it allows the car to be moved during loading, often of considerable advantage from the standpoint of reducing machine de-

lays. In addition to the usual type of switching arrangement, special track layouts are used at the face by some operators. Examples include the four-rail, three-track and six-rail, three-track systems developed by the Linton-Summit Coal Co. for use with track-mounted loaders (April, 1934, *Coal Age*, pp. 125-128).

Generally, where mobile loaders are employed, loaded trips are assembled in an adjacent room, and though a locomotive in most cases could make a round trip during the time required to load a car, the absence of changing facilities near the face with either the one- or two-unit haulage system would mean that in addition to the necessary switching and coupling time the machine would be idle for an additional period equal to the time required for a round trip from the face to the mouth of the place. Again assuming 160 ft. as the average length of a working place and 4 m.p.h. as the average locomotive speed, changing on the entry rather than at a point 30 ft. (on an average) behind the face would require 0.8 minute additional per change. When this is compared with an average loading rate of 0.75 tons per minute, which is exceeded in most cases, and a labor cost alone of as much as 18c. per minute, saving these fractions of minutes takes on added importance.

Relay, or swing, locomotives may be a necessity where mobile loaders are used, as the time required for the gathering unit, whether the sole unit or one of two, in taking trips to the sidetrack means an undue loss in loading time unless the movement of such trips can be synchronized with the movement of the loading machine and also the operation of the main haulage unit serving the section.

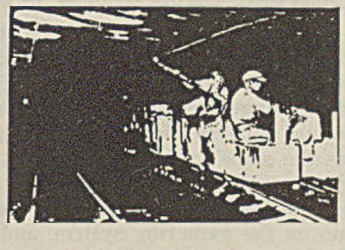
What of Conveyors and Scrapers?

The considerations cited above for hand-loading and the operation of mobile loaders apply with equal force to pit-car loaders. Where conveyors or scrapers are used, however, opportunity is afforded in almost all cases for loading in trips, and this should be the goal where this type of equipment is employed. Also, conveyors and scrapers are by nature semi-permanent installations, which means that they must be stopped at times to allow cutting, drilling, shooting, timbering and other operations to take place, though this may not always be the case where longwall systems are employed. Such systems, therefore, greatly simplify haulage; yet possibilities for improvement still remain.

One measure is the location of sidetracks as close to the loading point as possible. Gathering units should be free to serve as many units as possible, which dictates the use of hoists and car pullers to handle trips at loading points where gradients will not serve the purpose. Where a number of units discharge onto the same entry, separate loading tracks at each loading point are necessary to avoid interference. Another alternative is the installation of the main service track in a parallel entry where roof conditions or other factors prevent the laying of two tracks on one entry. Even when only one loading unit is operating on an entry, a loading track may be advantageous that changing trips can be done on the spot.

The loading of trips in entries driven with conveyors or scrapers has its own problems. Usually, the coal is brought to a track laid through a crosscut, though with some types of equipment sufficient storage capacity can be obtained by laying track in the same entry parallel with the conveyor and using side-discharge equipment.

Main haulage differs from gathering haulage largely in that higher speeds are customary, the work of the main haulage units being primarily the transportation of trips of cars from point to point, rather than distribution and re-



assembly of trips within a given mine section. The size of a trip which a main-haulage unit can start and continue to pull, maximum full-load running speed and the length of the haul therefore determine the tonnage that it can handle, subject, of course, to delays in transit and waiting time, either at the bottom or back in the mine. Conditions limiting the tonnage output of a haulage unit therefore can be stated in more detail as follows: tractive effort exerted by the locomotive (a function of the weight and adhesive power between the wheels and the rail, assuming sufficient motor capacity); rated speed; gradients; track conditions, which may limit average running speed; train resistance; length of haul; ratio between coal and car weights; and time lost in waiting, as distinguished from that lost in wrecks, equipment failures, etc.

Even though dispatching may require the purchase of telephones or other means of communication, it probably is one of the least expensive methods of increasing the efficiency of main haulage and the transportation system in general. The favorable results derived from dispatching grow out of the coordination of the movements of gathering and haulage units, plus the coordination of car distribution and demand in the various sections, both tending to eliminate delays which otherwise would prevent both transportation units and loaders from accomplishing a normal quota of productive work in a given time. Dispatching also may be extended to the control of demand peaks (March, 1934, *Coal Age*, pp. 95-100), and the dispatcher's record is in effect a continuous time study which can be used as a basis for keeping the transportation system up to the mark.

Haulage Ailing? Try Dispatching

Available records indicate a substantial improvement in transportation efficiency, accompanied by a corresponding increase in loader output, at all operations where dispatching has been installed. Possibly one of the most comprehensive studies of actual transportation performances was that completed a few years ago by the West Virginia University School of Mines, covering 42 operations in that State. Ten of the twelve operations producing 2,000 tons or more per shift and eight of the 30 producing less than 2,000 tons employed dispatchers. Comparative results were as follows: no dispatcher—tons per main-line locomotive per shift, 614; per gathering locomotive, 155; per unit of stock, 72; dispatcher employed—tons per main-line locomotive per shift, 678; per gathering locomotive, 199; per unit of stock, 109. Expressing main-haulage efficiency in terms of ton-miles per shift: operations not employing a dispatcher averaged 746; with dispatcher, 1,217.

Installation of dispatching usually is accompanied by the use of some type of signal system both to aid in the movement of trips and promote safety. However, signal sytems in themselves, plus some form of automatic or semi-automatic switchthrowing equipment, are worthy of study as a means of increasing both haulage efficiency and safety, particularly on main lines.

Where main-line locomotives already are working close to a maximum capacity and improvements in other directions, including voltage adjustments, have been carried to limits commensurate with cost, increasing capacity usually requires the purchase of new equipment, though it may be possible in some cases to increase capacity of present units to a certain extent by the installation of motor-cooling equipment, usually blowers. Use of special insulating materials also is a possibility. If spares are available, it may be possible to convert two smaller locomotives into a tandem machine by the expenditure of a few hundred dollars. Purchases of new locomotives, in addition to other factors, should be made with an eye on the possible effect on demand, which might in some cases be vitally affected by the starting of heavier trips behind locomotives larger than those previously used. However, if not already covered in an improvement program, sufficient progress may be possible in other directions

to offset the effect of larger trips, as will be indicated hereafter.

While necessitating a more or less substantial investment, grade reduction, track improvements and special haulways frequently result in worth-while savings by improving over-all mine efficiency, and in some cases may avert the purchase of additional transportation equipment. Where main hauls inside the mine reach unusual lengths, construction of short cuts (either inside or outside) may result in a material saving. Though not always feasible, this possibility is worthy of consideration, and in some cases may be the determining factor in the removal of the surface plant to a new location. In certain cases, by the expenditure of $10,000 to $20,000, main-line hauls have been shortened by ½ to 1½ miles, with corresponding effect on efficiency.

Better Roads or Less Tonnage?

Poorly ballasted track laid with light steel on ungraded and undrained roadways usually is inadequate to meet the requirements of present-day haulage with its higher speed and heavier loads. Transportation improvements therefore must take into consideration track conditions. Heavy grades may reduce output by limiting trip size, and also may increase power demand. Light track poorly maintained and with unduly sharp curves may necessitate a voluntary or involuntary reduction in speed if wrecks, damage to equipment and consequent interruption to other activities dependent on haulage are to be reduced.

Sixty-pound steel is none too light for main haulage roads, and 40-lb. generally is the lower acceptable limit on secondary roads. In working sections, the tendency is more and more toward 25-lb. rails, and at some mechanical-loading operations where heavy equipment must travel to the face steel as heavy as 35 lb. per yard is employed. Improvement programs adopted by several companies show that cost of drainage, elimination of heavy grades and the construction of main-line tracks of 60- or 70-lb. steel on creosoted ties with gravel, crushed rock or slag ballast may run as low as $10,000 per mile, and that the resulting improvements in efficiency may range up to 25 per cent. Savings in maintenance of both roadways and rolling stock also are important items.

Theoretically, it might be said that as the mine car acts solely as a convenient container, its rôle in the transportation system is a passive one. Actually, however, size, design and number may exert a vital influence on all mine activities from the face to the surface plant. Size and number together are a measure of car capacity in use, which generally is reflected in the output of the individual loader. This is borne out by the West Virginia study hereinbefore cited, which showed that districts with a high average car capacity in use per loader also enjoyed a correspondingly larger individual output. No hard and fast rule for car capacity per man can be set up, due to the wide variations in conditions from mine to mine, but any program undertaken to increase loader performance should include a survey of available car capacity. In this connection, it also should be remembered that distribution plays a part in the capacity required. Where the time required in transit is reduced, a single car may be loaded oftener in a shift, thus cutting down the number required. Because of the close interrelationship between all elements in transportation, however, the principle of a requisite number of cars should not be overlooked in a drive for high turnover, which is not necessarily a measure of efficient operation.

Paralleling in importance the question of the number of cars in use is the individual capacity. By installing cars with a higher capacity, many of the difficulties encountered in a transportation system already working at a peak may be eliminated at one stroke. While the effect on main haulage, in general, is not so marked, due to its character, this step means an immediate reduction in car changes in gathering. As the changing time is for all practical purposes the same whether the capacity is large or small, installation of larger cars results in an immediate decrease in the strain on the gathering system, and the gathering units therefore can cover more territory or serve the same territory more efficiently. Reduction in changing time growing out of larger cars is an especially important factor where mobile loaders are employed. Where stock is used, however, installation of large cars may require its displacement, because animals may be unable to handle them. Where hoisting is the practice, larger capacity per car means fewer hoists for a given tonnage or that the hoist, in the absence of other limiting factors, can handle an increased tonnage in the same length of time.

Details Count in Cars

One of the outstanding characteristics of present-day types of cars is the fact that the increased capacity can quite frequently be obtained with no increase and often with a decrease in dimensions, particularly height, thus easing the task of the loader and enabling the car to work with existing transportation facilities, such as hoists. Another result of increasing capacity without corresponding increase in dimensions is a reduction in ratio of car weight to coal weight. Better design also plays an important part in this result. This lower ratio, together with the decreased resistance of anti-friction bearings, increases the net weight of coal that can be hauled per trip by the same haulage unit, and also is reflected in the demand established in starting. The same trip may be started with a lower demand or a larger trip, possibly with a larger haulage locomotive, may be started with the same demand.

Maintenance expense and longer life also are factors to be considered in installing modern cars. Alloy wheels and axles, anti-friction bearings, cast-steel underframes, all-welded construction, corrosion-resisting steel, spring draft and buffing gear and a generally sturdier construction all combine to reduce maintenance cost, prolong life and keep cars in service. Where larger individual capacity or other considerations are not governing factors, modernization of existing equipment to reduce train resistance and maintenance costs often will show worth-while returns. The increasing use of anti-friction bearings, special wheels and alloy-steel axles are evidences of this trend.

Fitting Hoisting to the New Job

In hoisting, shorter working time presents no particular problem where sufficient reserve capacity is available. If, however, the hoist already is working at or near capacity, several possible avenues of relief are open, including speeding up the hoisting cycle, decreasing caging time, changing drums or installing larger cars. Speeding up the hoisting cycle involves higher acceleration, with attendant effect on steam pressure or purchased-power peaks, and relief, therefore, should be sought elsewhere first as a general rule, unless these factors can be disregarded.

Caging practice may offer prospects of substantial improvement with a relatively small investment in modern car-feeding and caging equpiment, which in some cases will cut caging time in half or even more, depending on previous practice. Where electric hoists are used, reduction in caging time or speeding up the hoisting cycle, or both, may result in dangerously high motor temperatures where reserve capacity is not great. This problem has been met at some operations by the installation of forced-draft cooling systems, though this practice is limited in its possibilities by the maximum rate of dissipation of the heat through the insulation.

As pointed out above, larger capacity mine cars may solve the hoisting problem in addition to the other economies they make possible. With modern design, it is entirely feasible to raise capacity materially while maintaining dimensions that will permit the car to meet existing shaft limitations. Consequently, it is possible to hoist the same tonnage without increasing the previous operating rate, and in a few cases experience has shown that the hoisting cycle may be slowed up, with consequent reduction in acceleration stresses and power peaks, not to mention a decrease in the strain on the engineer.

SURFACE PREPARATION

+ Too Often Neglected in Quest for Lower Costs

COAL PREPARATION is an activity carried on directly for the benefit of the consumer and indirectly, by supplying the user with a fuel more suitable to his requirements, for the benefit of the producer. Consequently, market developments have been directly reflected in widespread improvements in preparation in recent years, though developments initiated by forward-looking operators have been a scarcely less important factor. That there is an intensification, rather than a lessening, of this trend is a conclusion that cannot easily be disputed, and, in addition, late developments in the industry, particularly the seven-hour day (with an allowable maximum of 7½ hours in preparation-plant operation) at bituminous mines, brings up new problems in preparation, as well as in all other phases of operation.

Where reducing mine price is eliminated as a market weapon, now the case in the bituminous industry, promotional efforts must turn on the shipment of an improved product which, in spite of its increased bulk costs, will still be less costly to the consumer through greater convenience in use or the liberation of a greater quantity of heat per pound, or both. Even where increased production costs, with their corresponding reflection in delivered costs, are not involved, this is still an important factor. In addition to the problems growing out of necessary price increases in the past few months, the latest step in the bituminous program also brings up the problem of increasing hourly capacity of surface plants to avoid involuntary limitation of output.

Increasing hourly throughout without extensive additions to equipment generally turns on the elimination of delays due to intermittent flow of coal from the mine, stoppages in the plant itself for various reasons and hitches in the movement of empty and loaded railroad cars to and from the loading point. Where delays due to mine operation cannot be eliminated, adequate raw-storage capacity is one of the easiest ways of keeping the preparation plant in operation. This storage capacity may be afforded in two ways: construction of storage hoppers or the use of mine cars. If sufficient cars are available, the latter may be the cheaper method, and by proper handling of the storage supply it may be possible to spread out the dumping of cuttings and thus eliminate many of the difficulties growing out of passing the entire output of this size through the plant in a short space of time.

Avoidance of mechanical failures within the plant requires both proper design and application of equipment plus adequate maintenance. In general, a study of motors, drives, equipment hangers and supports, and lubricating methods frequently will reveal possible improvements. Where the plant is fairly large or consists of more than one unit, coordination of operation dictates the use of signal systems. Interlocking controls also are a widely used method of avoiding lost time due to overrunning and attendant spillage of coal or damage to equipment.

Railroad-car storage and movement, due to derailments, stiff cars, ice and blockages resulting from lack of flexibility in track arrangement, are a frequent source of interruptions at preparation plants. Gravity, of course, is the cheapest motive power, but entails proper design of yard facilities if it is to be fully available as a means of moving cars. Yard tracks, therefore, should be maintained to grade, well drained, properly ballasted and free from low spots. Switches and crossovers should be designed to offer as little resistance as possible. Positive yet flexible control of the car at the loading station is essential, which means the use of some form of car retarder. Maximum flexibility in loading also may dictate moving the car back and forth, which would require power-operated pulling and retarding equipment. An ample number of crossovers, both above and below the loading point, will prevent blockages and thereby increase the average loading rate. Where steam is available, piping along the tracks and around switches, frogs and crossovers will eliminate major cold-weather problems. If these problems are severe, an even more expensive heating system may be warranted.

With delays from various sources, including those enumerated above, eliminated, the next point of attack in increasing average throughput is the preparation process itself, including equipment. It is seldom possible under present conditions, however, to divorce this question from the problem of meeting new market requirements, which are, in many instances, an even more powerful incentive for revision. Consequently, changes at an individual preparation plant, even when initiated originally to increase capacity, should take into consideration the fitness of the

Saving the Squeal

It is not generally a question these days *whether* preparation should be revised but *how*. Both market conditions and, lately, capacity problems, must be solved. Methods naturally will vary, but it is possible to set up a number of guideposts.

Is hourly capacity a problem? Possibly elimination of mine, plant and yard delays or the installation of storage facilities will solve it without purchase of addtional equipment.

Do market changes require shipment of a large range of sizes? Investigation may show that high-speed shaking and vibrating screens and mixing equipment can be installed and the number of loading points increased without radical plant revisions.

Is seasonal influence on the movement of a particular size or sizes marked? Crushing facilities, storage or, in the cast of slack, briquetting, are possible solutions.

Are present cleaning methods inadequate to meet market requirements or causing an undue loss of good coal? Revision of hand-picking methods, employment of auxiliary units to supplement present mechanical cleaners or the installation of new mechanical equipment, frequently carrying with it the possibility of real operating economies, may supply the answer.

reconstructed operation to ship (*a*) a product that is cleaner or has other desirable characteristics enhanced; (*b*) a more uniform product, either in chemical characteristics, proportion of various size fractions between the upper and lower limits of a particular size, or percentage of undersize and oversize; (*c*) a wider range of sizes; and (*d*) blends and/or mixtures of sizes. Proper evaluation of these factors, when related to the operating and maintenance advantages of modern equipment, will determine the extent of reconstruction to meet present and future market requirements or whether an entirely new plant is necessary.

Increasing capacity where no other changes are contemplated may be accomplished by increasing the speed of feeders, conveyors, screens, picking tables, loading booms and other equipment, as well as the rate of feed to mechanical-cleaning units. This will necessitate, in most cases, changes in drives, and when efficiency—as measured by the character of the shipped product—and resultant operating stresses are considered has certain practical limitations, beyond which purchase of additional equipment becomes a necessity. The usual step in the latter case would be more or larger units of the original type. Another possible alternative with attractive possibilities would be installation of special cleaning or screening equipment, either in the original or a separate structure, for treating certain fractions of the feed, thus relieving the main plant of the burden of handling the entire output. Mechanical cleaning units for certain sizes and rescreening plants for junior sizes are examples.

Markets Tough? Scan Preparation

While developments growing out of coding have brought the question of plant capacity — already influenced to some extent by the need for better preparation to meet higher consumer standards—more sharply into the limelight, new market conditions, as outlined above, have been of equal or greater importance in preparation modernization. Hand-picking and screening still is the leading preparation method in the bituminous field, though its supremacy is challenged by mechanical cleaning, for years the accepted standard in the anthracite region. Improving the efficiency of hand-picking naturally turns largely on more accurate spotting and removal of refuse and substandard material. Accepted methods of accomplishing this objective include lowering the speed or decreasing the depth of the coal on the picking equipment, increasing the number of pickers or broadening the range of material removed. A further factor is proper illumination, too often neglected.

Screening practice at both hand- and mechanical-cleaning plants has been undergoing a marked change in recent years, due to the growing demand for smaller sizes in the bituminous industry and stricter standards covering degradation, undersize and oversize. Anthracite preparation practice has long been based on the shipment of a definite list of sizes distinguished by the absence of products corresponding to bituminous slack or screenings. Though soft coal has not yet approached anthracite in the extent to which screening is carried, it has been faced with the problem of a growing demand for finer sizes. This has brought up the question of additional screening facilities, which generally have been met by the employment of high-speed shaking screens and vibrators. These generally require but little space, making their installation in an existing plant or small addition easy.

Traditional practice at soft-coal mines, as compared with anthracite, where cleaned coal generally is loaded from pockets on one loading track, is founded on loading each size on a separate track. Increasing the number of bituminous sizes therefore poses the question of loading arrangements. Construction of extra tracks may be a costly procedure, even where topography is not a bar. Construction of pockets also may be a difficult and costly job, though not always so, leaving as the most likely solution direct loading at two or more points on a single track. Individual plant conditions will determine the feasibility of this procedure, but proper selection and location of screening, conveying and loading equipment, plus the construction, in certain cases, of a small storage hopper or hoppers, may be the cheapest and most convenient answer to the problem.

Mixing facilities are a necessity at practically all bituminous plants, hand or mechanical, particularly where routine screening practice results in the production of more than the traditional number of sizes. The trend toward smaller sizes, coupled with seasonal variations in size demand, also has thrown the spotlight on crushing, long an accepted part of the preparation routine at hard-coal mines. Crusher location varies in accordance with plant conditions, but in general units are located so as to receive the coarse size or sizes either from the loading booms or the mixing conveyor, the product being chuted directly to the railroad car as slack or returned to the fine-coal screens, if installed. While crushing large coal to small may be regarded as a necessary evil, and therefore favored with little attention beyond oiling the equipment, it is possible, by careful choice of equipment and operation, to reduce the proportion of fines in the crusher product and thus secure a greater yield of the larger fractions.

Storage of seasonally slow-moving sizes, though possibly not strictly a preparation problem, has been a fairly general practice at anthracite operations for years. In the bituminous industry, slack usually constitutes the most difficult problem, and code developments tend to make it more so by eliminating the price concessions frequently relied on in the past to move distress tonnage. Lack of storage space also constitutes a major difficulty in mountainous country, though by no means an insurmountable one, as, in the absence of space at the plant, milling-in-transit rates may allow shipment to a suitable location. Equipment and methods are dependent on both the terrain and the rate at which the material must be stored and reclaimed, varying from a scraper pulled by a tractor to an elaborate system of extensible belts.

Still further removed from preparation proper but bearing directly on the disposal of fines is briquetting. By this method, a number of operations have solved the slack problem by installing briquetting plants of various types and thus converting a low-priced industrial coal into a high-priced domestic fuel.

What Mechanical Cleaning Offers

Although hand-picking as a cleaning method may be entirely satisfactory in a number of instances where market requirements and the character of the coal permit its use, it is not applicable to sizes under 2 in. and also is open to the objection that uniformity of product cannot be guaranteed. These and other drawbacks have been responsible for the growth of mechanical cleaning, and any study of preparation improvements should not overlook the possibilities of this method of preparing coal.

Possible operating advantages frequently have been subordinated to competitive possibilities in past installations of mechanical-cleaning equipment. This is particularly true at bituminous operations, and, while it is a vital factor, it should not be allowed to obscure the possibility of substantial operating economies. Depending upon the results desired and respective plant design and operation, replacement of hand-picking or older types of mechanical equipment with modern mechanical cleaners may yield a part or all of the following advantages: increased yield of prepared coal per mine car, due to higher recovery of coal values; greater yield of prepared or domestic sizes resulting from decreased degradation (particularly true where an old plant employing a number of low-capacity mechanical units and the necessarily elaborate handling facilities is replaced); lower power cost (true only under the condition cited just above, as a general rule); decreased labor cost through shifting cleaning from pickers to machines and also from a reduction in the number of machine-tenders required; and lower maintenance, growing out of fewer, better-designed machines with larger individual capacities. The above

are, of course, in addition to the primary objective of a cleaner, more uniform product.

Loss of coal values, while it does not, as a rule, appear under that head in the cost sheet, may be an important factor, especially if the loss includes an appreciable quantity of the larger sizes. As a matter of fact, the operator loses two ways: he pays for producing the lost material and in addition is penalized the amount he would have received in the market. The higher the unit production cost and selling price, the greater this loss becomes. Consequently, the possibility of a reduction should not be overlooked in studying hand-picking or present mechanical-cleaning methods.

Mechanical cleaning, on the other hand, brings in the question of so-called "reject" or "conversion" cost, which is, in effect, the cost to the operator of producing material thrown out in the cleaning process. In view of the other competitive and operating advantages of mechanical cleaning, this should not be set up as the sole test of acceptance, and in addition, such a cost cannot fairly be designated as one experienced solely with mechanical cleaning, as a certain reject cost is incurred through the removal of refuse in hand-picking, although it is not so large as in mechanical cleaning. One method of reducing reject cost is the removal of all possible waste material at the face.

Hand-Picking Not Excepted

While frequently limited, opportunities do exist for decreasing the loss of coal values with hand-picking. In addition to better training of pickers and other methods of increasing efficiency outlined above, it may be possible to segregate lumps containing good coal and chip off the impurities by hand. A corollary is mechanical reduction in size to free impurities, for which the rotary breaker, which accomplishes breaking, separation of impurities and sizing in one operation, frequently is employed. Crushers also are used at a number of operations, the product being returned to the screens, from which it finds its way to the proper picking equipment.

Where mechanical cleaning is employed, recovery of coal values, excluding sludge or dust, may take either of two major forms: re-treatment of refuse from the mechanical-cleaning unit, which may be set to operate at a higher specific gravity if a cleaner product is desired; and the making of a three-product separation, with re-treatment of the middlings. The latter will depend upon whether the design of the equipment will permit such a separation. In any case, cost of recovery, when balanced against realization, will govern. A further factor which may bear on the picture in mechanical cleaning is the appearance of the material recovered. Although it might be good coal from the standpoint of the float-and-sink test, its appearance might make it impossible to sell.

Selection of mechanical-cleaning equipment should be based upon a thorough study of the coal to be cleaned. This cannot be emphasized too strongly. Such a study will show where cleaning is most necessary and the possibilities of improvement, thus determining the type and capacity of the equipment to be installed; also, it may throw light on the possibility of revising mining methods to eliminate material which could not be benefited by preparation. With the wide range of equipment available today, the installation can be tailored to meet the specifications in each individual case, whether a single unit is desired for one size or a large-scale plant for an entire range of sizes. Even when mechanical cleaning of all sizes from 4 or 5 in. down is the goal, it may not be necessary to wreck an existing structure, as large-capacity units of all types may be obtained for installation with a minimum of alterations.

Mechanical-cleaning units, assuming proper application and no change in the inherent qualities of the coal substance, can be depended upon to turn out a product that is both uniform and up to standard, provided operating conditions are not changed. Fluctuations in the rate of, or intermittent, feed; wide variations in the proportions of the various size fractions; and crowding of the equipment, however, may influence materially the analysis of the cleaned product. Adequate storage capacity ahead of the equipment, which assures an even rate of feed and no interruptions, is one of the best solutions to most of these problems. Such storage facilities, however, bring up the question of segregation of sizes, frequently a major problem. Arrangement of dumping schedules to spread out the input of one particular size (usually slack); proper design of the bins themselves, as well as the raw-coal conveying, elevating and discharging equipment; and separation of the raw feed into a number of sizes, which are deposited in separate compartments and later recombined in definite proportions, are examples of remedial measures.

No Substitute for Control

Efficient mechanical cleaning results are dependent also on the control of the equipment itself. Manual control is open to the objection that inattentiveness or faulty judgment on the part of the attendant are difficult to eliminate entirely, so more and more attention is being given to automatic controls, both for new equipment and units already in service. By controlling refuse discharge or water or air flow, or both, automatic equipment assures a more uniform product. In all cases, however, control, both human and mechanical, should be checked. Consequently, adequate sampling and testing equipment and a definite testing routine should be a part of all mechanical-cleaning set-ups, and should not be overlooked at hand-picking operations.

Experience has shown that dewatering is not a particularly difficult problem with coal over ½ or ¼ in. Under these limits, however, natural drainage does not function efficiently, which may make drying a necessity to avoid freezing or other troubles, which, in some cases, have led operators to bypass fines around washing units. Heat-drying has been adopted by a number of operators in the past two years for the smaller sizes, and new types of equipment have materially reduced the cost. High-speed vibrating screens equipped with either wire cloth or wedge-wire sieves with openings in the neighborhood of 1 mm. are a late development for dewatering fines.

Refuse-Disposal No Orphan

Constantly increasing pressure to reduce costs has left few mining activities, underground or surface, undisturbed in late years, including refuse-disposal. Although, in most cases, a minor, though necessary, activity, refuse-disposal may offer an attractive opportunity for savings, even where revisions require the investment of a substantial sum in equipment. In general, the employment of more than one or two men—or three, at very large operations—in this department should be regarded with suspicion, as it means in most cases that the possibilities of savings have not been explored completely. Separate handling of mine rock and preparation-plant waste may be an exception to this rule, although a study of the problem may reveal that rearrangement of methods will allow the two activities to be combined at a worthwhile saving.

Topography, due to its influence on the character and extent of storage space, generally is the major factor in the choice of a disposal system. As a result, there is a wide variation in methods, with consequent variation in equipment. Latest types available, however, include motor trucks, both with wheels and caterpillar rear ends; tractor-trucks, tractor wagons, various types of self-propelled electric larries and self-dumping cars, aerial tramways and conveyor systems, as well as movable overturning and gooseneck dumps for handling refuse in mine cars. With any one or a combination of two or more of these types of equipment, in combination with proper storage and loading equipment, it is possible to waste large quantities of material without, in general, exceeding the limits of manpower set out above. In a number of instances, it has been possible to cut disposal cost to as low as 5 or 10c. per ton of material handled.

Technical Program, Cincinnati Convention

American Mining Congress

Monday, May 7—10 a.m.

Introducing—C. M. Lingle, vice-president, Buckeye Coal Co., and chairman, program committee —*The Industry From the Practical Operating Standpoint.*

R. L. Ireland, Jr., vice-president, Hanna Coal Co., and chairman, Coal Division—*Facing the Future With the Coal Industry.*

J. T. Ryan, vice-president, Mine Safety Appliances Co., and chairman, Manufacturers' Section—*How Manufacturers Are Aiding Coal Industry in Solving Its Production Problems.*

Monday, May 7—2:30 p.m.

1. *Review of Mechanized Mining.*
   G. B. Southward, mining engineer, American Mining Congress.
2. *Comparative Results in Wet and Dry Washing.*
   T. K. Guy, consulting engineer, Charleston, W. Va.
3. *Promotion of Safety Educational Work Through Safety Meetings.*
   E. B. Agee, superintendent, Dehue Mines, Youngstown Mines Corporation.
   F. S. Lenhart, safety director, W. J. Rainey, Inc.
4. *Review of Newest Things in the Equipment Field.*
   Peter J. Loftus, consulting engineer, Pittsburgh, Pa.

Tuesday, May 8—10 a.m.

1. *Scouring Device for Removing Discolorations From Coal and Restoring Original Luster.*
   T. M. Dodson, vice-president, Weston Dodson & Co., Inc.
2. *Mining With the Coal Saw.*
   (Speaker to be announced.)
3. *Gathering-Locomotive Haulage.*
   John H. Richards, chief mining engineer, Hanna Coal Co.
4. *Constructive Safety Work.*
   E. L. Berger, general superintendent, Bell & Zoller Coal & Mining Co.
   M. L. Coulter, chief engineer, Clearfield Bituminous Coal Corporation.

Tuesday, May 8—2 p.m.

1. *Mechanical Loading of Slate in Entries and Aircourses.*
   C. W. Gibbs, general manager, Harwick Coal & Coke Co.
2. *Cleaning of Strip-Mine Coal in the Southwest.*
   K. A. Spencer, vice-president, Pittsburg & Midway Coal Mining Co.
3. *Drilling at the Enos Coal Mining Co.*
   C. R. Barnard, chief engineer, Enos Coal Mining Co.
   J. B. Melville, receiver, Electric Shovel Coal Corporation (discussion).
4. *Various Methods of Roof Support.*
   A. R. Joyce, The Koppers Co.

Wednesday, May 9—10 a.m.

1. *Underground Distribution of Power.*
   K. L. Konnerth, electrical engineer, H. C. Frick Coke Co.
   W. P. Vance, general superintendent, Butler Consolidated Coal Co.
2. *Wet-Cleaning of Small Sizes.*
   B. C. Osler, general manager, Pardee Bros. & Co., Inc.
3. *Various Methods of Shooting Coal in the Harlan Field.*
   Pearl Bassham, vice-president, Harlan-Wallins Coal Corporation.
4. *Promoting Safety as a Sound Investment.*
   James F. Bryson, director of safety, Harlan County Coal Operators' Association.
   William Roy, safety director, Hanna Coal Co.
5. *Mining Company Town—Its Government, Its Sanitation, Its Social Outlook and the Ideal It Should Represent.*
   William Beury, vice-president, Algoma Coal & Coke Co.
   W. A. Borries, general superintendent, Dawson Daylight Coal Co.

Wednesday, May 9—2 p.m.

1. *Efficient Use of Electrical Power.*
   M. W. Horgan, mining representative, Monongahela West Penn Public Service Co.
2. *Coal Sampling.*
   D. A. Russell, chief chemist, Youngstown Sheet & Tube Co.
   M. H. Forester, preparation manager, The Consolidation Coal Co.
3. *Cleaning at the No. 4 Plant of the Pond Creek Pocahontas Co.*
   F. C. Carothers, superintendent, Pond Creek Pocahontas Co.
4. *Stripping Operations at Colstrip, Montana.*
   D. R. Swem, manager, coal operations, Northwestern Improvement Co.
5. *Protective Clothing and Safety.*
   C. G. Brehm, supervisor of safety and compensation, Susquehanna Collieries Co.

Thursday, May 10—10 a.m.

1. *Air Shooting—An Entirely New Process.*
   C. J. Sandoe, vice-president, West Virginia Coal Co. of Missouri.
2. *The Energy Air Miner.*
   Fred A. Miller, mining engineer, Franklin County Coal Co.
3. *Cleaning Plant, Binkley Coal Co.*
   Walter E. Rutledge, vice-president, Binkley Coal Co.
4. *Progress of Mechanical Loading at the Gunn-Quealy Coal Co.*
   G. A. Knox, superintendent, Gunn-Quealy Coal Co.
5. *Efficient Haulage Systems.*
   E. H. Jenks, mining engineer, Rochester & Pittsburgh Coal Co.

Thursday, May 10—2 p.m.

1. *The Competitive Fuel Situation.*
   C. B. Huntress, president, Appalachian Coals, Inc.
2. *Latest Practice and Results in Dedusting.*
   Arthur F. Nesbit, consulting engineer, Wilkinsburg, Pa.
3. *Effect of the Coal Code on Safety and Discipline.*
   C. F. Keck, mine inspector, Jamison Coal & Coke Co.
4. *Use of Mounted Cutting Machines.*
   D. D. Wilcox, general superintendent, Superior Coal Co.

Friday, May 11—10 a.m.

1. *Use of Gunite for Roof Control.*
   C. E. Hough, engineering department, Federal Coal & Coke Co.
2. *Safety in the New River District.*
   Charles E. Vawter, assistant engineer, Gauley Mountain Coal Co.
3. *Shaker Conveyors and Their Adaptation to a 22-Deg. Pitch.*
   P. H. Burnell, superintendent, Owl Creek Coal Co.
4. *Capacity of Pit Cars and Relation to Mechanical Loading.*
   I. N. Bayless, assistant general manager, Union Pacific Coal Co.

POWER-COST ECONOMIES

+ Revealed in Thorough Electrification Survey

SO MANY opportunities for reductions in power costs exist that no mine that has not already examined the subject in detail can afford to neglect a complete and searching investigation into every item of equipment and operating method which in any way affects the monthly bill for energy. Further operating economies can be found both at mines generating their own power and at mines operating on purchased power. Although to some degree practically every change made to reduce the cost of power at a mine using central-station service would also be effective at a mine generating its own power, consideration will first be given to the mine operating on purchased power, because the possibilities for cost reductions are greater there.

In the approach to the goal of the lowest possible power cost per ton of coal produced consistent with the application of electric power to every job on which it holds promise of effecting an economy, reduction in the net unit cost per kilowatt-hour and in the kilowatt-hour consumption per ton of coal produced should have equal weight. Too many coal-mine operators declare that they scrutinize only the power cost per ton and leave the kilowatt-hours per ton to take care of themselves. That view may appeal to the executive who has no time to probe deeply into details, but the official who overlooks nothing in power-economy detail must also watch the cost per kilowatt-hour and the kilowatt-hours per ton. Only when he has reduced both of these to their lowest point has he exhausted the possibilities for lowering the power cost per ton.

Practically all power-rate schedules provide for a lower net rate as the amount of energy used is increased and as the demand peak or the demand average for a 5- to 15-minute period is decreased. Other schedules provide for lowering the net rate when power factor is raised from a lagging factor and is brought close to unity (100 per cent) power factor. Only the demand and power-factor provisions present possibilities for practicable reductions in the unit cost of energy consumed.

When striving to reduce demand, mine pumping—if an appreciable load—is the first target for investigation. Perhaps, without expense, practically all the pumping load can be shifted to hours when other loads are off or light. The cost of equipping pumps with automatic controls, time clocks, float switches, priming devices or of constructing larger sumps to obviate operation of pumps during peak hours may be returned in a short time through savings in demand charges.

Dispatching of haulage locomotives offers the next most favorable opportunity. Gains from more efficient operation of equipment and better servicing to the coal loaders will more than pay the cost of employing a dispatcher. The lowering of power demand by dispatching locomotives with due regard to other load conditions will be a net gain. It has proved a distinct advantage to have the same man in control of all electric loads at the plant. This requires that his office be equipped with indicating and demand-period timing and synchronizing apparatus. An outstanding example of the savings possible through this system is furnished by the experience of one company in the Appalachian field which thereby reduced demand 40 per cent (*Coal Age*, March, 1934, p. 95).

Many companies, especially those operating small to medium-sized mines, employ demand limiters to open a circuit breaker automatically when a predetermined demand is about to be exceeded. Reports are common of limiter installations costing $100 to $200 which have retired their cost in two to three months. If the circuit opened by the limiter is the d.c. feeder to the mine, there is, of course, some loss by reason of the delay and the restarting of the equipment. A demand-limiter adjustment which causes the circuit to be opened only three or four times per day, however, may save 10 to 20 per cent of the demand charge. The better managed a mine is the more careful is the analysis required to determine the number of interruptions which can be suffered to secure a certain reduction in demand.

Decreased demand by shifting cutting to the night shift or to some other period free from peak loads will also return a neat dividend unless the change increases other expenses, such as the cost of supervision. One 50-hp. cutting machine in hard cutting will increase the 15-minute monthly demand charge as much as 30 kw. because, even in room work, the actual cutting time may be over the 15 minutes and some one of these cutting periods during the month probably will fall in synchronism with the 15-minute interval of the power company's demand meter. The more machines in use, however, the less chance of all of them cutting for a full 15 minutes in synchronism with the demand interval. For example, with ten machines in use, the 15-minute demand of the ten would not likely exceed 50 per cent of "ten times 30 kw."

Although, to the non-electrical man, "power factor" may be a theoretical term, it is, nevertheless, of outstanding practical importance when the purchased power-rate schedule adds a

Check?

Have you tried reducing your demand charge by: (1) shifting your pumping load, (2) automatic control, (3) load dispatching, (4) demand limiters, (5) cutting on the night shift?

Can you improve your power factor by: (1) operating induction equipment close to capacity, (2) switching to synchronous motors, (3) installing capacitors, (4) adjusting the field current of synchronous equipment?

Is it better to purchase power or generate the juice at your own plant?

These are some of the questions raised—and answered—in this survey of power-cost economies.

penalty for operation below a stated power factor and allows a bonus for operation above that figure. Power factor may be defined as the ratio between the power actually furnished and the power registered on the consumer's meter. The difference between the two represents current furnished for magnetizing induction equipment but not registered on the consumer's meter. To provide this non-registered energy means investment in generating capacity and transmission equipment for which the central station seeks compensation either through the power-factor charge or, where no such charge is made, in its general rate schedule.

If all the electric load at a mine consisted of lamps, electric heaters and "100 - per - cent - power - factor" synchronous motors, the power factor of the total load would approximate 100 per cent. All other loads that contain windings, such as induction motors and transformers, inherently operate at a power factor less than unity, but the closer to capacity this equipment is loaded the higher will be its power factor. Non-investment methods of increasing power factor include arranging induction motors and transformers so that they will operate close to capacity, cutting certain transformers off the line during hours they are carrying no load, and operation of synchronous motors with the field current adjusted to produce the maximum benefit to power factor. Investment aids include the replacement of induction motors on fans, pumps, blowers, air compressors and other equipment with synchronous motors, or installing capacitors or synchronous condensers.

How to Improve Power Factor

There can be little excuse for not taking full advantage of the non-investment aids. Shifting of motors may result in the replacement of large induction motors with smaller ones which have to be purchased, but the large motor displaced may have a resale value far in excess of the cost of the new small machine. Disconnecting "not-loaded" transformers from the line may require only a slight bit of extra work on the part of some employee and occasional supervision by an official. Proper adjustment of field current of synchronous motors, particularly m.g. sets carrying the typical varying mine loads, is not as simple. Only a specialist in this work can properly determine the most economical field setting for the various loads on the machine, taking into consideration the amount of other load and its power factor as well.

As an example, a 300-kw. synchronous substation unit, located some distance from the tipple and equipped with full automatic control, was operated 24 hours per day at the high field current necessary to enable it to carry the short-time peak loads and at the heavy loads maintain close to unity power factor. The result was an unnecessary heating loss in the synchronous field during many hours of the day; during the night, there was a definite loss as the result of operation at a low leading power factor when no induction motors were on the line. A partial reduction in these losses could be effected by sending a man to the substation twice a day to adjust the field rheostat; maximum reduction, however, involved the addition of an exciter so connected that the synchronous-motor field current varied automatically with the changes in load.

A practical way to compensate for or counteract the low power factor of induction motors is the installation of capacitors or, to use another name, static condensers. If, after other conditions have been adjusted to the best advantage, power factor still lies in the range making possible a rate bonus for further correction, installation of capacitors is almost certain to prove a paying investment. Recently a large bituminous company with five mines installed ten 70-kva. capacitors at a cost of $8,000 and, as a result, cut its power bill approximately 12 per cent per month. Figuring the economic size of the capacitor necessary, it should be added, is a job for a technical specialist.

Meter All Current

The search for reduction in the kilowatt-hours consumed per ton of coal mined opens up many avenues for checking waste in the utilization of power. A few years ago, for example, power leaks to company-owned houses were substantial; now, the majority of companies have installed house meters and have completely checked that loss. Any use of electric heat, even in company buildings such as stores, offices and weighhouses, should be eyed with suspicion.

Lighting in company buildings, tipples, preparation plants and other structures should be turned off when not needed. This may require changing circuits and switches to make manipulation more convenient, or, in the case of a machine shop, providing for low-intensity general illumination and high-intensity local illumination for hours when only a few men are working overtime in the shop. If close supervision and intelligent limitation on the use of power allotted to various buildings and to various mining operations are to be attained, metering is essential, since meters furnish the only means for determining, by comparisons, which loads require the most supervision to reduce total power consumption.

Substantial savings can be effected in power consumption of substation units by shutting down equipment during periods when the operation of such equipment is not absolutely necessary. Conversion losses may easily mount to 25 per cent of the a.c. input at the substation. To check these losses, as many motors and loads as possible should be changed from direct to alternating current; where possible, all d.c. loads should be eliminated during certain hours, thereby permitting a complete shutdown of all substation equipment. Such a shutdown, of course, means a marked saving in power. Where pumping is an important factor, the installation of a turbine-type deepwell pump with motor located at the top of a borehole eliminates the necessity of running d.c. pump motors during the hours the mine is not operating.

Education Still Needed

Despite a vast amount of educational work, uneconomic power losses in d.c. circuits continue to be the most common fault in power utilization at the mines. One of the best ways to build up and maintain a distribution sytem to an approximate economic quantity of conductor is to approach the problem from the standpoint of maintaining a voltage which will operate the equipment at the proper speed and at a temperature which does not adversely affect production and maintenance. For example, if, in using 250-volt equipment, the operating voltage in any section is not allowed to drop below 200, it is practically certain that line and rail circuits will be maintained close to the proper balance between allowable energy losses and the charges to maintain the circuits.

When those holding the purse strings can be impressed with the fact that tracks with rails of large cross-section present current-conducting possibilities equivalent to copper conductors of over 1,000,000-circ. mil area, they will see to it that those rails are properly bonded to take full advantage of the existing conductor. The difficulty lies in maintaining a proper check on bond condition. To hire an outside inspector to make frequent tests of each individual bond and prepare a report on the general condition is admittedly expensive. Unless each bond is tested, however, there is great chance of error in arriving at an over-all measure of bonding efficiency.

If such testing is deemed too costly, the possibility of error can be minimized by a high-current resistance test of the d.c. circuit, including the track portion. This is done by lowered voltage and short-circuit or by applying a heavy load for a few moments. It is a quick test to determine the over-all bonding efficiency and leaves no room for argument as to whether certain bonds were missed in the test. If, after bonding efficiency has been brought close to 100 per cent, the voltage at the load centers or at the farthest points of utilization drops below economic values, then only is it time to consider adding copper feeder. No quantity of copper feeder in the outgoing or trolley circuit will com-

pensate for an open circuit in the return. Any lack of proper bonding is an approach to open-circuit conditions.

Frequently power costs are increased by adding a mining machine or a locomotive to increase or maintain production when the same result could be obtained by improving the circuit condition and thereby increasing output with existing equipment. If, however, bonding is in first-class condition and the voltage still is low, there should be no hesitancy then in investing in copper feeder rather than in additional equipment.

Relocation of substations either by moving permanent equipment or by shifting the position of portable outfits for the purpose of maintaining the center of d.c. distribution close to the center of load offers another opportunity for reducing energy consumption. Depth of cover as affecting cost of boreholes for feeder-cable installations, characteristics of the mine from the standpoint of safe and reliable installation of 2,300-volt inside feeder cable to inside substations and the production life of the mine section in question are all factors to be weighed in deciding whether it is better to add more copper to compensate for longer d.c. transmission or to move the susbtation. It is, of course, impractical to set any empirical limit on the length of d.c. transmission, because the amount of the load is the controlling factor; not many cases exist, however, where it pays to transmit 250 volts more than a mile for a period of years.

Cutting Ventilation Costs

Substantial savings have been made in power costs for ventilation by replacing equipment, changing operating methods and improving airways. Many mines, however, have not taken full advantage of their opportunities in these directions. Generally speaking, more savings can be made by these changes than in revamping strictly electrical features. Wound-rotor induction motors operating continuously on resistance should be avoided. The slower speed should be secured by changes in drive ratio or by the installation of a lower-speed motor. Operation "on resistance" during certain hours and on idle days, of course, will save many times the loss in resistance, but, here again, if half-speed or other fractional speeds possible with a multi-speed motor will suffice, it is economy to install such a motor.

A slow-speed direct-connected synchronous motor is the most economical in power consumption in driving large fans. The higher first cost of this type of equipment is offset to some extent by the elimination of auxiliary equipment for mechanical drive connection. Great care must be exercised in selecting equipment for such an installation, because there can be no later speeding up of the fan to increase air delivery. But this inflexibility is really an advantage in that the fan always will be operated at the proper speed for maximum efficiency and also in that airways must be maintained to circulate the required volume of air without additional pressure.

With the increasing use of anti-friction bearings, lubrication assumes less importance as a factor in power requirements per ton of coal produced. If lubrication is applied properly to prevent undue wear of equipment, then the energy-loss consideration barely exists. In tipples, preparation plants and on certain types of conveyors, however, lubrication is almost certain to be slighted unless handled by automatic or centralized control. A survey of electrical energy losses, therefore, should not overlook these possibilities.

Avoidable losses common in mine-locomotive operation are due generally to the use of equipment geared to greater speeds than are necessary for efficient haulage; to parallel operation of motors when series operation would be satisfactory; to wheel slippage where locomotives are too light for the loads; to stopping and starting on curves and grades where it would be possible to eliminate those stops. Changes desirable from the standpoint of power conservation are also necessary for low maintenance and production efficiency.

When Is a Bit "Dull"?

Every mining man knows that cutting coal with dull bits means power wastage. But what is a dull bit? In establishing a standard and in maintaining bits to that standard lies the principal opportunity for reducing power waste in cutting. An accurate test of the energy increase per square foot of cutting as a set of new bits is used to "dullness" will indicate the time when, for that particular type of bit steel and character of coal, it would pay to declare the bits "dull" and change to a new set. Application of hard-surfacing to the bit points gradually is gaining in favor. One large company increased the number of tons cut per bit tenfold by hard-surfacing.

Where local conditions are favorable, substitution of mine-generated for purchased power probably offers the greatest opportunity for a reduction in the power cost per ton. What are the most favorable conditions? In order of importance they are:

1. Availability of a fuel product of little or no market value.
2. Abundance of water requiring little or no treatment.
3. Large load in a small area.
4. Non-existence of hoist motors that are large in proportion to the remaining load.
5. Existence of a steam hoist.
6. Long life of mine or group of mines to be served.

Although few, if any, situations embrace all these conditions in favorable measure, the existence of one in full measure or two or three in small measure may justify the investment in generating equipment. New plants built at mines during the last two or three years are reported to be earning 20 per cent and upward annually on the investment made.

The investment cost for a mine power plant ranging from 500 to 3,000 kw. probably will fall between $70 and $120 per kilowatt of installed capacity. The quantity of continuous water supply, the quality of the water and the permanency and appearance of the building are factors which influence the cost. Two of the most recent installations are non-condensing, but all have stoker-fired water-tube boilers with automatic-control features.

No Place for Hand-Firing

Hand-firing would seem to deserve no consideration in the design of a new plant, because, even with a good grade of fuel, not one fireman in a hundred will manipulate the furnace and boiler so as to keep his average preventable fuel loss below 25 per cent and also because less boiler overload capacity is available. With stokers and automatic control, there is no difficulty in holding preventable fuel losses to 5 per cent and in operating the boilers at 200 per cent rating.

If a high-ash (20- to 40-per cent) refuse fuel is available, selection of boiler-room equipment involves a choice between stokers and pulverizers. It is possible to handle a much higher ash fuel with pulverized firing and to use coal dust from a preparation plant. Not long ago a company in the smokeless field replaced its hand-fired horizontal-return tubular boilers with one 600-hp. pulverized-fuel boiler and thereby effected a fuel saving of $1,000 per month by utilizing refuse as fuel in place of the mine-run formerly burned.

Selection of engine-room equipment may require a careful analysis of conditions and a close understanding of equipment efficiencies and performance. For units with a capacity of 500 kw. or more, the condensing direct-connected turbo-generator is likely to be the wise selection. If it appears best to operate non-condensing and if the money is available for the extra investment, it may pay to install engines instead of turbines, operating at perhaps 30 lb. of steam per kilowatt-hour instead of around 40 lb.

Given the opportunity to choose between purchased and mine-generated power, the question is asked and rightly so: What is a reasonable bogey for electric power cost per ton at mines with favorable conditions? Naturally, this is difficult to answer, but at mines not equipped with mechanical cleaning or with loading machines, 3c. per ton of coal shipped is "a figure to shoot at."

MAINTENANCE

+ Points Way to Lower Costs Per Ton

IF REDUCTIONS actually made by some companies that have given intensive study to the problem offer a fair gage, there are many mines that could halve their present total maintenance costs. Much of this saving could be achieved without additional investment; the rest of the reduction would require expenditures for the replacement of parts of defective design with parts of improved design. Inasmuch, however, as reductions in per-ton maintenance costs invariably result in increased efficiency in the use of equipment through cutting down delays, the drive for such reductions should be continuous. With the shorter work-day demanding more from present equipment and/or new investment in additional equipment, improved maintenance methods offer a fertile field for exploration by management seeking to make the most out of the new set-up.

Personnel First

Personnel organization should be the starting point in the drive for lower costs in this sphere of coal-mine activity. There is no particular difficulty in obtaining competent men to do the actual repair work. Usually failure to keep maintenance costs close to the ideal possible under the conditions prevailing at a particular mine can be traced to a failure on the part of management to centralize responsibility and authority in the hands of a man who understands the fundamentals of proper maintenance and who has sufficient grasp of each detail to be able to see their relation to the whole picture.

Divided authority encourages noncooperation. Where, for example, a chief electrician is responsible only for electrical maintenance, a master mechanic or haulage and machine boss for mechanical details and a shop foreman or superintendent for major repairs to electrical or mechanical equipment, low maintenance costs are impossible if any member of this supervisory group fails to appreciate fully the effect of the interrelationships on net costs.

Where such division exists, the solution—obvious, but neglected by many operations suffering under the handicap of excessive maintenance costs—is to give one official control over all phases of maintenance work. In many cases this centralization may be done without adding another man to the payroll, as one of the departmental heads may be given the over-all authority while still continuing to exercise direct personal supervision over his particular department. Under such a set-up, it is then proper to hold this man responsible for the over-all maintenance cost at the mine, provided always that he is given adequate authority and is not hampered at every turn by some superior official unsympathetic with his policies and willing to achieve a temporary, illusory low over-all cost of operation at the expense of proper maintenance.

Centralization of authority, however, does not mean the elimination of free interchange of ideas between subordinates and between the departmental chief and his subordinates. Any attempt to eliminate such interchange must work to the detriment of the department as a whole. Lack of experience, of initiative or facility in reasoning through and in getting his ideas across on the part of the man in direct charge of equipment at a mine may militate against speedy achievement of anticipated results. Regular meetings of local groups, where all phases of maintenance are discussed, can do much in remolding a man who has ability and who is not by nature too set in his ways.

What Are the Best Methods?

Maintenance methods most successful in reducing costs and increasing operating efficiency include:

1. Regular inspections of equipment to uncover minor conditions which, if uncorrected, would lead to major difficulties;
2. Thorough overhauling of equipment in place of continual repairing;
3. Eliminating by change in design those features of a particular piece or type of equipment which repeated trouble has shown to be economically inadequate to the service;
4. Replacing with new equipment of modern design and capacity older equipment and types which, because they are unfitted to the service in which they are used, result in high maintenance costs.

A practical illustration of the application of the policy just cited is furnished by the experience of a large mine operating in the Pittsburgh seam. Because of the long haul and severe grades, main haulage costs with existing equipment were unduly high. In purchasing new equipment, the maintenance cost was one of the primary considerations in a final decision to specify 40-ton units made up of two 20-ton locomotives in tandem equipped with special anti-friction journal bearings. As a result, maintenance costs on main-haulage equipment at the mine dropped to less than one-fourth of the former figure. Five years passed before it was necessary to turn the tires, whereas three months had been the average life of a new tire on the old locomotives before turning was necessary. The longer life of tires on the new equipment is due to the fact that the units are of ample weight to start the trips without wheel slippage and with the application of very little sand.

Tuning the Locomotive

Locomotive maintenance presents several possibilities for improved practice. Few mines pay enough attention to the tendency for looseness or play to develop in the drive. The effect of this tendency is cumulative and is responsible for the major items of locomotive maintenance. When motor-case bolts are allowed to work loose, and are left in that condition for any length of time, the fit of the bearing housing is affected and play develops which transmits shocks to the armature, bearings and other parts. Axles are allowed to wear below standard, with the result that, even though new axle brasses are applied, the gears do not mesh properly. This condition causes a heavy thrust, which in turn destroys the axle brasses by the rolling action under high pressure. Worn journal-box guides, loose rivets and worn thrust-collars all help to aggravate a condition which is reflected in rapid wear on each of the other parts.

More frequent or more thorough inspection, or both, coupled with proper tightening of motor-case bolts will prevent wear of housing bearings which fit correctly at the beginning. Adding metal and machining should be done where fits have been allowed to wear. Building up worn axles by arc welding or renewing the axles after reduction in diameter amounting to approximately $\frac{1}{32}$ in. is the treatment for the malady. Prevention of rapid recurrence may require fitting a housing over the axle between the axle bearings and occasionally forcing grease into the space under the housing so that the lubricant will work out through the axle bearing and thereby prevent, or at least counteract, the entrance of sand and dirt. With all parts made to fit without play, gears fitted to mesh properly and precautions taken against entrance of dirt, the life of parts will be extended many times that under "loose-fit" conditions.

Electrical Details Also

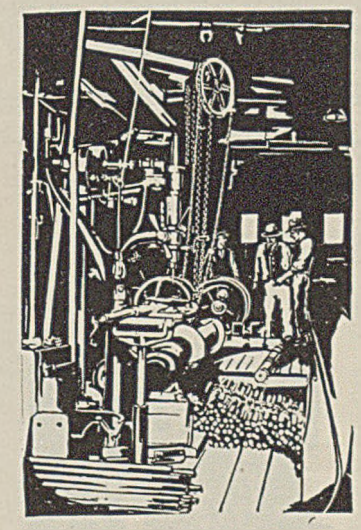
Proper maintenance of the strictly electrical parts of the locomotive is less commonly neglected than proper maintenance of the gear-mesh assembly. Beginning with the armature, there can be no such thing as doing too good a job on a rewind or commutator repair. Best materials available, work done by the most careful workmen available and supplied with the most modern shop equipment bring results none too good for the duty imposed. Thermostatic protection of motors is the only sure way of preventing a degree of overheat which will destroy or weaken the insulation. Controllers and switches must be of sufficient capacity for the duty; parts and connections must be kept tight; and contacts must be kept clean and treated regularly to a small quantity of lubricant.

Choice of locomotive tires covers a wide range, but steel tires still lead. These are replaced after being worn to the minimum practical thickness. At many mines, tires are never turned but are kept free of false flanges by the use of abrasive brake-shoes. One turning during the life of the tire, however, is the more common practice. Usually the tires are annealed before turning, although some companies with extra-heavy-duty lathes turn without annealing to eliminate the cost and prevent softening of the tire, thus prolonging its wearing life.

Filling by electric welding continues to be the common practice in reducing tire cost. Welding a steel strip into the groove is still being done, but some mechanics consider it necessary to prepare the groove in a lathe for proper seating and for edge-welding the strip. Filling the entire groove by use of an automatic arc-welding machine appears to effect the greatest savings.

A number of large companies have standardized on rolled-steel wheels as more economical than the use of tires. The first cost approximates that of a tire, while the cost of renewal of wheel centers is saved, and cutting and fitting keys and keyways for wheel-center mounting is eliminated, because rolled-steel wheels are mounted press-fitted without keys. Those who have had no experience with rolled-steel wheels may contend that their use will increase axle renewal costs because of the reduction in axle fit size after two or three renewals of the wheels. The answer to this contention is that as a rule the axle by that time has been worn below standard tolerance size at the axle bearings and is ready for renewal or building up because of that wear.

Mining-machine maintenance does not present as many specific problems as locomotive maintenance. The same general rules with respect to inspection to forestall serious trouble and to thorough and complete overhauling, however, are equally applicable. The necessity for thorough overhauling is emphasized by the compactness of the parts and by the fact that a complete



inspection cannot be made without considerable dismantling of the machine. *So far as possible, repairs made in the working place should be confined to minor adjustments and renewals.* The coal face is no place to renew a part which requires extensive dismantling, accurate workmanship, good light and freedom from dust and dirt. Complete assemblies of certain units should be made in the main shop and kept ready for sending to the crippled machine. This reduces repair time and practically eliminates the chance of error due to the conditions under which a delicate job would have to be done inside the mine.

Badly worn cutter chains and cutter-bar parts can cause endless trouble and expense. Thorough overhauls and rebuilding with strict adherence to standards governing the tolerable wear in a part to be used in the rebuild are, as every good mechanic knows, the preventive.

Loading-machine maintenance requirements differ but slightly from those involved in the proper care of cutting machines. As the improved models of loading machines with their increasing number of anti-friction bearings go into use, unavoidable wear is reduced. By the same token, however, it becomes more important that repair and replacements be handled by highly competent mechanics who appreciate the care and precision that should be exercised in the assembly of parts. General overhaul becomes a highly specialized job.

Strictly speaking, proper handling of underground equipment by machine operators is not maintenance, but this proper handling can effect a tremendous saving in maintenance costs and a material increase in production efficiency. No equipment can be made so foolproof that it will withstand needless abuse. The greatest reduction in maintenance costs, therefore, cannot be attained unless the use of the machine in production service is carefully analyzed and abuses in such use are corrected. Obviously, if the goal of the lowest possible maintenance costs for the mine is to be reached, the official in charge of maintenance work must have the authority or backing to secure reasonable care in the handling of the equipment by the men using it in the mine.

Not Forgetting Pumps

Pumping-equipment maintenance assumes broad proportions when large quantities of water must be handled and the water is highly acidulous. It will pay to investigate and test the latest alloys available under actual local conditions, and then, taking into account first cost, labor involved in replacements and average operating capacity and efficiency, decide which type of alloy is the cheapest from the service standpoint.

Selection of the most economical alloy for coal chutes, which are subjected to the severe combination of abrasive wear, acid water and oxidation, calls for careful study and consideration. Here again first costs may be deceptive. Tests made by Keene and McFarland (*Coal Age*, October, 1933, p. 355) indicate that alloy sheets carrying a unit-area cost fifteen to twenty times that of plain steel may so outlast the latter that the ultimate cost per unit of service would be much less.

Certain types of equipment, such as mine fans and substations, which operate under selected and fixed conditions and upon which the entire mine depends for production and safety should be almost free from maintenance costs. Large items of maintenance cost mean delays that should not be tolerated from other operating standpoints. The obvious answer is to replace faulty equip-

ment or parts with equipment that will be reliable and trouble-free.

Lubrication is a major part of maintenance. The total cost of the oils and greases used plus the labor cost in applying them properly belong in the maintenance budget. Reducing these costs, however, should be secondary to securing adequate lubrication, which offers no special difficulties where equipment such as stationary motors and mine cars equipped with properly housed antifriction bearings is concerned. Mining and loading machines, locomotives, certain types of conveyors and preparation plant equipment, however, present real problems in lubrication.

Conveyors carried on link-and-roller chains can be adequately and economically lubricated only by automatic devices which squirt a drop or two of oil on the right points at the ends of each roller. Much of the other preparation-plant equipment can be properly lubricated only with pressure greasing. To assure that no parts are missed and to approach the ideal of feeding a small quantity of lubricant gradually or at frequent intervals, a centralized automatic greasing system is necessary. Less effective alternatives are the hand-operated centralized type and the grouping of hand grease-gun connections at a convenient point near each group of bearings.

Lubricant characteristics are highly important in certain types of service. On equipment such as a mining-machine chain or a wire rope which runs in coal dust, the lubricant must have sufficient body to cling and yet must penetrate to the inside. Extreme heat or wide variations in temperature on another type of equipment call for still another type of lubricant. Design of some bearings in an assembly that is lubricated from a common reservoir may call for a lubricant that must be within close limits of a stated viscosity. Uniformity of product, therefore, is a necessary feature of any line of high-grade lubricants.

Proper maintenance of equipment is so closely tied in with successful operation that one cannot exist without the other. The efficiency of man-power in the mine depends to a great extent upon uninterrupted operation of equipment, and the productive capacity of equipment cannot be kept to the maximum demanded by the shorter working shift if operation is to be hampered by breakdowns of machinery with the resultant delays in the flow of tonnage.

INVENTORY CONTROL

+ Also Plays Part in Cost Reduction

SHEER NECESSITY has been one of the most compelling reasons for the great reduction in supply cost accomplished in the past few years. The practices acquired during the lean years should not be forgotten with improved business, however, as the primary object of any supply system should be prompt service to prevent interruptions in production, an especially important point now that the shorter working day in the bituminous industry has thrown an extra burden on producing facilities.

Inferior materials or parts have no place in the supply system, regardless of lower cost, if their shorter life or decreased reliability may result in operating delays. The experience of one company which three years ago began the purchase of scrap railroad-car axles for making mine-locomotive axles offers an example of the possible disadvantages of this practice. In service, these axles broke sooner than those made of the regular grade of new steel used prior to that time; now the company is purchasing the toughest steel recommended for this duty and as a result has eliminated axle failures from the list of causes of equipment delays.

Speed in delivering supplies, particularly repair parts, to trouble spots requires the maintenance of a supply close to the point of use. Consequently, it may be advisable to keep a small stock of certain inexpensive items underground or, in the case of a compact group of mines with a central warehouse, to store a small quantity of material in a local warehouse at each operation. However, close supervision is required to prevent abuses of this plan which might result in the building up of excessive quantities of supplies at local points, thus encouraging unnecessary use and similar wasteful practices.

Different mines require different types of supervision, but in every case responsibility should be placed in the hands of one man who may do the work himself or supervise others in charge of the actual distribution of supplies. No material should be issued by a supply house without a written order from the proper official. The superintendent is the logical man at smaller operations; at larger operations, signing of supply orders should be limited to as few officials as practicable.

The value of the perpetual inventory and order system is so well recognized that its use is common practice. Likewise, warehouses fitted with an adequate number of storage bins of wood or steel are now the rule rather than the exception. Some companies find that it pays to make physical inventories of warehouse stocks oftener than once a year. Errors on the perpetual inventory cards therefore are detected early, decreasing the possibility of delays due to important parts being found "out of stock."

Another advantage of frequent physical inventories is the promotion of better accounting practices and the earlier detection of waste and irregularities. Use of a special card attached to the bin while the inventory is being conducted promotes accuracy and allows the work to be spread over several days, thus avoiding the employment of extra help. Receipts and disbursements during the inventory period are marked on the special cards, which are collected when the inventory is completed and compared with the perpetual-inventory cards. These bin cards are then filed for further use until all of the space is exhausted.

A large inventory of repair parts and supplies is costly for many reasons. Lack of standardization is the factor most often responsible for this condition. Correction lies in the standardization of equipment as far as possible, and also in the standardization of the supplies themselves. Every purchase requisition should be checked for conformity with the standards established for the mine or group of mines, including quantity. Where one company operates several mines, it may be possible to fill the requisition from overstock at another operation or from material derived from equipment that changes in conditions at one operation have rendered obsolete. By exerting proper pressure, it is possible to achieve a reasonable degree of standardization of equipment at one operation over a period of years. Used equipment may be traded to other mines to the advantage of both. When a new type is adopted, all the old equipment, where possible, should be replaced to eliminate the necessity for keeping a stock of repair parts.

"Local conditions" naturally are one of the major reasons for a high supply cost, but they should not be allowed to overshadow the possibilities of the controllable factors. Regular staff meetings present opportunities for impressing foremen and other mine officials with the importance of careful attention to supply costs and distribution.

SAFETY

+ Indispensable to Modern Mine Operation

SAFETY, a growing mining cost, is one where, with only too many companies, economies can be effected if proper effort is made. Where operations are speeded, safety is too often overlooked in anxiety for speed, and cost of accident is sure to increase if necessity for safety is not kept steadily in mind. The seven-hour day, therefore, is not without its unfortunate connotations, though it should not be difficult to reconcile increased hourly tonnage with safety. In fact, the mining, steel and railroad industries—to mention a few only—have made progress in daily tonnage and in units per man employed, with a reduction in accident rate per employee.

In every large mine or company there should be at least one safety man whose business it should be to head up safety activities, to inspect the mines, to study accidents and suggest remedies. Most reports on accidents omit many of the most important details, as to the man himself, his fitness for the job, his eyesight and the light he was furnished. The report too often seems framed to fit the accident into a definite classification rather than to relate it to the fact, remote or immediate, that caused the accident to occur. The alert manager will return them for further details.

Hurried investigation sometimes fails to go into the question of method and construction that would make such an accident well-nigh impossible. What happened is not so important as what can be done about it. Evidence thus gained should be embodied in standards and specifications and revisions of both. Here is the clew for which management should have been looking, but, if it does not fit the classification, it is often overlooked and its teaching is not pressed.

Accidents to equipment also need investigating. Hardly a single accident of this sort, derailment or other, but might have proved fatal or disabling had someone happened to be in the place where the failure took place. To give an illustration: Some cars were being coupled on the head of a plane leading to an underground mine slope. The cars ran down the slope and were derailed. It was found they had torn down some wiring and were lying upside down. No serious damage was done, and what there was soon was mended, but nothing further was done.

A man might have been in the car or at the scene of the accident, for it was both a man slope and a car slope, but, as no one was killed or injured, no inquiry seemed essential. Just these are the conditions on which the accident rate fattens. Too many are anxious to put such threatening conditions out of mind, but unless they are put beyond possibility, nothing but misfortune can eventuate. In this case, a runaway switch kept open would have guarded the slope.

The shorter day will be likely to speed up transportation—one of the most dangerous features of mining. Some classes of transportation average more than one accident a year. An accident per man per year is rated as 100 per cent, so the accidents of transportation may be rated as over 100 per cent, sometimes as much as 150 per cent. But it must be added that these accidents usually are not fatal. In Indiana mines, as judged by the fatality returns from 1922 to 1931 inclusive, the relative hazards are as in Table I (see U. S. Bureau of Mines, I. C. 6672).

Table I—Fatalities by Occupation, Indiana 1922-1931 Inclusive

Classification	Total Fatalities	Employees Approximate Per Cent	Relative Hazard Per Cent
Shotfirer	39	0.8	100
Mine bosses	8	0.5	34
Drivers	31	2.0	31
Cagers	9	0.8	24
Motor or passing bosses	2	0.4	23
Trip riders	35	3.4	21
Room bosses	8	0.8	21
Trappers	5	0.5	21
Laborers	22	2.5	18
Mining machine men	42	5.1	17
Firebosses	5	0.6	17
Topbosses	3	0.4	14
Timbermen	9	1.5	13
Electricians	9	1.5	13
Tracklayers	16	3.1	11
Superintendents	3	0.5	11
Pumpers	3	0.5	11
Surveyors	1	0.2	11
Shot-runners	1	0.2	11
Miners	252	50.1	10
Motormen	18	3.8	9
Drillers	7	1.7	8
Loading machinemen	13	4.3	6
Hoisting engineers	2	0.4	6
Top labor	11	8.1	3

Fatalities of drivers, cagers, motor or passing bosses, trip riders, trappers and motormen, when added, total 100, and the percentage proportion of such men total 10.9. The relative hazard on the basis taken is almost 19.

Indiana may not be typical and some of the classifications are too small for generalizations, but it is interesting, nevertheless, to note how much less is the risk experienced by the miner than by the transportation worker of almost every class but the motorman.

It is transportation hazards that increased speed is likely to increase. In most mines, more coal could easily be obtained if only it could be hauled, so the burden of any program for greater tonnage is likely to be transportation speed. More important than any other provision for providing greater safety in transportation is better track as regards weight of rail, heavy rail joints, braces and elevation on curves, track elevation, properly laid switches, good ties, well-drained, well-aligned and well-graded track, good ballast, for these provide against derailment, but all this would not protect the cager and only in a degree the trip rider.

The former's accident rate could be reduced by caging equipment for feeding cars to the cage—keeping these men from foot of shaft—by car-feeding equipment and by use of hooks for coupling. The latter's accidents are in the main from jumping from moving trips, from running to switches, from throwing switches, from striking the roof, from electrocutions and from being caught in narrow places. These accidents can be avoided partly by keeping a clean track—though jumping from moving trips should be forbidden—by providing easily acting switches that are operated either from a stand or by a switch lever acting parallel

with the track; by keeping adequate height and by guarding wires wherever, as at switches and partings, the trip rider or others will have to leave the trip; by using dielectric shoe soles and by keeping adequate and uniform heading clearances above and beside the cars.

Accidents due to parting of trips are best avoided by use of good couplings and also by draft gear that will reduce the shocks of starting and stopping. Such draft gear also saves power in starting and reduces peak loads, lowering power costs, avoiding excessive wear on short-circuiting devices and maintaining voltage for mechanical operation. Stronger cars and better bearings prevent car failure—a prolific cause of derailment, parting of trips and collisions with parted trips. Tail lights also reduce accidents. So also does proper signaling equipment.

Safety of Miners

Accidents to miners are reduced by provision of timber of right length, necessary supply of timber, which is now considered a part of the dispatching program, provision of good cap-pieces and wedges cut to the needed shape (thereby providing for safe roof supports eliminating the use of axes and making the setting of a prop a job of a few minutes and, therefore, one not likely to be delayed); supervision; standardized posting with enforcement of standards; use of safe explosives; safe methods of shooting; warning against shots; short-circuiting of fuses and use of mechanical or lamp batteries in place of line current.

Other provisions are safe transport of explosives by miners or delivery of explosives by other means; drilling, loading and shooting of holes by a force of men employed solely for that work; storing of explosives and primers in safe places remote from working faces; keeping of cartridges separate from primers; assurance of the freshness of explosives by avoiding accumulations at any time of old stocks of explosives; avoidance of attempts to fire too many shots for the capacity of the battery used for that purpose; prohibition of shots fired into pillars where insufficient pillar makes it likely that the gases from the explosive will fire into excavations filled with firedamp or explosive dust.

Use of permissibles or pellet powder will meet the hazards of making cartridges in the presence of open lights and the danger of leakage of the explosive in the hole, also the danger that kegs of powder will be opened with steel implements. Miners should be required to use wooden tamping bars. Even copper bars will cause sparks. A heavy bar is likely to cause excessive compression of the charge, with danger of explosion. Better ventilation may prevent men from having to return to work before smoke clears away, thus avoiding accidents from falls of roof and coal, and also will prevent methane explosions at the coal face.

Provision of proper car stops will prevent men from being crushed by cars in dipping faces. If such are not supplied, the men should be properly instructed how, by the use of posts, a safe stop can be provided. Use of safety posts should be mandatory, especially at the loading point and far more frequently along the working face than has hitherto been customary. Men should be instructed when posts must be set to comply with the rules for normal roof, and told to post whenever and wherever posts are needed, without waiting on the time and place that the rules define. An immense number of posts, indeed, would be needed to pay compensation for a human life.

Stop, Look and Listen!

Hurry rather than speed makes a mine unsafe. If right methods of operation are adopted, safety can be assured. Transportation, perhaps, levies almost the highest toll per employee engaged in any class of work, cagers and trip riders especially having high death and accident rates. But most of the fatalities are those of miners, because of the great number thus employed. Accidents to equipment are the least costly of warnings of danger to men, and the most numerous. Such warnings should be heeded before they result in human casualty. The more remote causes of accident should be sought as well as those directly classified.

Dangers From Roof

Roof should be tested by jarring rock with a bar and feeling for vibration with a wood stick. Men should have bars and should not bring down loose rock by picks, which, when the roof gives way, may cause the miner to fall forward under the roof. If the bar fails to bring down the rock which threatens to fall, it much be shot or posted. Loose coal should be barred down. Spragging of undermined coal should be demanded if unshot coal is at all loose. Where a shot primed by squib or powder fuse fails, the miner should stay out of the place for at least one hour. Shots which fail should not be drilled out or drilled into.

Care should be taken, by drilling holes ahead and at angles to the working face, to avoid breaches to standing water in old workings, old mines, faults or buried valleys where these are suspected.

Shot firers stand at the head of the preceding list in relative hazard. Men will overcharge shots, making the work of the shotfirer very dangerous. Some advocate that miners fire their own shots, urging that they then will not overload them, being faced, if they do, with the consequences. One mine that has that rule has an abnormally low accident rate from shooting, as also from other operations. Those who load shotholes should see that the holes have sufficient confinement.

Of all wastes, none is more costly than an explosion. Ventilation will aid greatly in reducing this danger in all mines where gas is found. In many so-called non-gassy mines, gas is emitted, but removed by ventilation; but if ventilation fails, danger is imminent. Care should be taken to keep the mine well rock-dusted, especially in return airways and at the face. Stress is laid on these places not because there is no danger in the intakes but because least attention is too often given to face and returns where the newest, finest and greatest quantity of dust is found and methane may be in high percentage.

Safety's Advocate

The function of watching for danger, while everybody's business, should have its special advocate and mentor. This man should report to headquarters and his reports should be distributed to company controller, manager, superintendents and foremen. In a large company, he should have a competent force of inspectors. Other safety men are foremen and sectional foremen, who report, however, to the foremen and superintendents of the mine, not to the safety department. Safety records of these men should be kept, both as to accidents and as to discipline meted to other employees, and if an accident occurs or the record in general is bad, they should receive additional admonishment or discharge.

Men who disobey safety orders and regulations should be disciplined in accordance with a set rule. After a certain number of disciplines in a year, they should be discharged. Unsafe men, if they leave, should not be rehired. In reductions of force, they should be the first laid off. Records of discipline may be posted in the rooms of the men disciplined, with reasons for discipline.

Records of section foremen should be posted. Rewards and bonuses may be paid for good records. Mines with no lost-time accidents may be signalized by flags on the tipple or headframe. But, above all, superintendents must be made to feel that big tonnage or low operating cost is not enough. Their safety records also should determine their standing with the company. First-aid training makes for safe employees, and every man in the mines should be taught first aid. Safety clothing, hard hats, hard-toed shoes, goggles, gloves, and in cases leggings, should be obligatory, and loose clothing is dangerous, as it may catch in cars and mining equipment.

DRAINAGE

+ Can Draw Off Profits as Well as Water

MINE DRAINAGE, except under unusually favorable conditions, represents an expense which continues as long as the mine operates, including shutdowns of a temporary nature, and in certain cases, particularly where agreements covering protection of neighboring properties prevail, even after work is discontinued permanently. Seasonal fluctuations in rainfall or changes in mining conditions may influence the rate of flow but do not remove entirely the need for drainage facilities, leaving as the only avenue to relief reduction of cost to the minimum.

Excluding special methods, such as air lifts, siphons, water hoists, etc., the two principal types of water-handling facilities in the coal industry are pumps and drainage ditches or water tunnels. An initial investment is required in both cases, usually substantially higher when ditches or tunnels are constructed. Pumping, however, entails continuous expenditures for attendance (which may be sharply reduced where automatic control equipment can be used), power and supplies, while ditches and tunnels operate by gravity, which costs nothing, and generally require but little maintenance and few supplies beyond periodic cleaning and replacement of timber along tunnels and ditchways. In certain cases, the savings due to the elimination of pumps and attendant expense has warranted expenditures of as high as $700,000 for tunnels with the expectation that the investment would be returned in fifteen years or less.

Tunnels discharging to the surface are, of course, an impossibility at a large number of mines. The same also applies to ditches opening to the outside, but this should not be allowed to obscure the possibilities of ditching underground for draining local swags to a central point and thus eliminating a number of subsidiary pumping units. Local conditions will influence the possibility of using ditches and also their cost, but no study of drainage should overlook the opportunities for savings in this direction. Final choice of pumps or ditches naturally will depend upon the relative costs of building and maintaining ditches as compared with the cost of installing, operating and maintaining a pump or pumps and the necessary discharge lines. Where conditions are favorable, it also may be possible to drain low spots to the outside through inclined diamond-drill holes, which have the same advantages as ditches and tunnels.

Of the two general classes of pumping, gathering is the most subject to inattention and neglect, in spite of the fact that it may represent a sizable expenditure for equipment, labor and power. Collection of the water in as few spots as possible offers major possibilities of relief, and in this connection adequate ditching can be a real help. Dewatering operations in working places, however, may require that each receive individual attention, and where this is the case truck-mounted pumping units either alone or in combination with water boxes may facilitate this task. Use of a number of automatic foot valves actuated by changes in water level may allow a single pump to draw water from a number of places through a single or branching suction line, which in some cases may reach a total length of 5,000 ft.

Main pumping activities have as their objective the lifting of large volumes of water to the surface or to another pumping unit in case the total lift is too great to accomplish in one stage. Pump efficiency and total head (static and friction) therefore are the most important factors. The former is largely a matter of design and maintenance, while physical conditions may limit the opportunity for decreasing total lift, thus leaving friction head as the principal factor within the control of the operator. Large suction and discharges lines and fittings which do not decrease the area of the pipe or create turbulence are commonly accepted practices. Regular cleaning of suction and discharge lines, where feasible, will prevent a decrease in diameter due to corrosion and deposition of sediment which, in aggravated cases, may reduce pump discharge as much as 50 per cent.

Inordinately long discharge lines may react seriously on the capacity of pumps, especially where corrosion and sediment are present. Consequently it has been found in a number of instances that replacement of such lines by boreholes direct to the surface has permitted the used of a much smaller pumping installation, thus reducing investment, maintenance and power costs. High maintenance and replacement costs due to acid water or the presence of abrasive materials may be reduced by the use of special metals and alloys in pumps and fittings and by the use of wood, fiber, rubber or alloy-steel pipe, or iron or steel pipe with special linings.

Automatic controls, due to their cost-saving possibilities, have been installed at a number of pumping station in the past few years, with savings reported to range from $5,500 to $50,000 annually. Through their use, all but the necessary supervisory labor is eliminated, a substantial item even where the pumps run only one-third to one-half of the time. By inclusion of the proper elements, automatic control systems can be adapted to any desired objectives and at the same time will provide protection against any conceivable interruption of normal operation.

Don't Wear It Out

Water in coal mines is a foreign material, and as such should be eliminated in the most direct and economical manner possible. Questions which therefore may be asked in determining the efficiency of drainage methods include the following:

Have the possibilities of ditches, tunnels and other forms of natural drainage been fully explored?

Will gathering methods meet the test of low cost and maximum efficiency?

Has friction been reduced as far as possible in suction and discharge lines?

Have the advantages of acid- and corrosion-resisting materials for pumps and pipe lines been thoroughly determined?

Will automatic controls on major pumping installations cut operating cost?

VENTILATION

+ Hides Costs and Losses Worth Uncovering

VENTILATION COSTS, in many mines, are a serious burden; how serious, each operation should be at pains to discover. Many ventilation accounts list under ventilation only labor expended in the erection of brattices, doors and overcasts; others add supplies for such erections thereto and also maintenance of return airways. Still others include power costs. Unless all proper items are included, figures for ventilation mean little or nothing. The importance of knowing just what ventilation is costing is considerable, and, if better understood, excessive cost would be sooner remedied.

Economies in ventilation divide themselves into two categories: (1) means for making ventilation more effective and (2) means for reducing ventilation wastes. If tonnage is to be obtained consistently and if each working place is to produce a large tonnage, in mines where shooting is allowed during working hours, the smoke and fumes from explosives must be promptly removed. In not a few mines, waiting for smoke to clear away would account for much of the low tonnage of miners, machines and gathering units, though, in mines producing methane, the necessity for removing that gas makes an adequate air current otherwise essential.

Especially are such delays in evidence at the face of advancing headings. Still more do they become long and vexing when bottom has to be lifted or rock shot down with heavy shots, and it is in such headings that speed of advance is most necessary. Unless main headings go forward rapidly, the number of cross headings is limited; unless the latter make suitable progress, enough room headings cannot be driven; and if room headings are delayed, mining cannot be restricted to a few of such headings. So some means must be obtained to get efficient ventilation in each type of heading.

For this reason, auxiliary ventilation is frequently desirable, but care must be taken always to use safe and effective ventilation methods. The auxiliary fan should force—not suck—air into the face, because only with a positive pressure can flexible tubing be kept inflated and because a suction fan will draw methane to the fan blades, where sparks may ignite it and cause an explosion. Flexible tubing is to be preferred, except for long tunnels otherwise unventilated. For such tunnels, a more substantial pipe is preferable for at least the greater part of the way.

Auxiliary fans should take no more than a fourth or a fifth of the air current, because of the risk of recirculation of methane or powder smoke, and they should be put at least 25 ft. away from the proposed path of the return air. The pipe, at least at its outlet, should be raised, so that it will not disturb dust on the floor or fail to act on the methane or lighter fumes at the face. Coal dust should not be disturbed, because it is explosive, and rock dust should be allowed to settle, because the breathing of dust is detrimental to workers. Both these conditions are favored when the pipe outlet is placed near the roof.

How Lack of Air Will Reduce Output

If all ventilation costs were considered, ameliorative action would be taken. Ventilation should be effective and economical. To promote the first, auxiliary fans, line brattices, curtains and bleeders may be used; to assure the second, attention should be given to fan inefficiency, fan unsuitability, resistance of airways, lack of adequate cross-section, leakage of current and recirculation at surface. Resistance and leakage are greatest where speed of current is greatest; therefore, attention should be focused on the points where the air travels at greatest velocity.

Wastes of time due to methane, fumes and poor-air lay-offs should be eliminated. More tonnage per hour involves a greater percentage of methane and more smoke; so ventilation, if not now in excess, will have to be increased.

Auxiliary fans should be carefully supervised, and it should be a rule that fans shall not be moved, except when and where ordered, for the miner, unacquainted with their hazards, may install them in a dangerous manner. The positive action of an auxiliary fan will drive methane out of high places, caused by falls of drawslate, more effectually than air delivered by the main fan, which air, traveling low and being under less immediate head, does not scour the face efficiently.

Where a room is driven in a lower coal bench and the upper bench is removed on retreat, ventilation is never really effective when the upper bench is being removed if methane that accumulates in spaces opened up by the removal of the top bench has to be removed through crosscuts excavated in the lower bench. Auxiliary ventilation will be more effective than any other in this instance also, though if "bleeders" have been made into the return airway of the entry ahead of the room being pillared, the air will then be carried up over the falls and will sweep the high methane with even greater effectiveness.

Ventilation of rooms also can be improved by placing a curtain on the heading short of the first room in the room entry and by driving a crosscut through the pillar along the cross heading or along the main heading, where there is no cross heading. Thus air will be carried from the cross or main heading almost to the face of the room, whence it may be directed to the face either by a line brattice or by the gob wall in the room.

Where the pillar between the first room and the heading that parallels it is too thick for the driving of such a crosscut or where the pillar between the first room and second room has been removed and the room has caved tight to the ribs, which usually does not happen for some time, the curtain should be placed in the room heading between the first room and second room to be ventilated, so that air will be forced up the first of these rooms to the face.

If the room gobs are filled with rock,

air naturally chooses the faces of the rooms and the most remote crosscuts for travel, but, where the gobs are not thus filled, air tends to travel across the gobs and through some of the other crosscuts. To prevent this, all the crosscuts except those nearest the several room faces should be curtained so as to keep the air from traveling through any but the most remote crosscuts, and, if necessary, line brattices should be provided in each room to carry air into the face.

With wide rooms and unfilled gob spaces, this may merely bring the air to the face, where it will make a bee line across the gob to the near crosscut leading to the next room, leaving the more remote corner of the room without ventilation, and it may be necessary to put a line brattice to the said crosscut on the far side of the room to compel the air to travel to the remote corner of the face.

Permanent Line Brattice

At certain well-ventilated coal mines where the rooms are wide and roads are laid against both ribs a wood brattice has been extended from post to post, not far from the center of the room. Just short of the first crosscut, a brattice is constructed to the road on the air-intake side of the room and a curtain thrown across the road to prevent the intake air from leaving the room or from crossing it to the other road. It is thus forced up to the face of the room round the end of the brattice and back to the most remote crosscut.

The wood brattice is extended only to the second row of posts from the face. These provisions allow the air to travel not only the roads but the open gobs on either side of the central brattice, and thus the resistance to travel is less than where one or two line brattices are used. It also gives a more even distribution across the face than a single line brattice would afford.

Where methane comes from falls along the break line, bleeders or crosscuts are made through to the return airway of the next room entry, and these bleeders are kept open, so that air will be carried over the fall and will sweep the methane away from the miners. By bratticing those bleeders that are opposite the first rooms in the break line, air will travel along the face and be carried in large volume over the falls in that part of the break line which is opposite the last rooms, effectually driving away the methane, which tends to be evolved in the break line adjacent to those rooms. However, much depends on where the greater part of the methane is being emitted. If the methane comes from measures high above the coal seam being worked, it may be best to let more of that gas pass through the earlier bleeders until the fall blocks the air entirely in that part of the goaf. Falls constantly change the quantity of methane coming from any point in the break line. It is necessary to try to provide the air in sufficient volume where it is needed, as determined by past and immediate experience.

High costs in main ventilation are due to (1) inefficiency of the fan as resulting from its own plan of construction, (2) unsuitability of the fan to the mine to be ventilated, (3) resistance of airways, (4) leakage of current, (5) recirculation at the surface. Many of the older types of fan are inefficient in themselves. Disk fans running at a low speed are ill suited to produce any more than a ½-in. water gage, at which gage they are fairly effective.

Table I—Limiting Distances Proposed for Certain Velocities

Velocities, Feet per Minute	Permissible Distances, Feet
2,000	100 to 500
1,400	500 to 1,000
1,000	1,000 to 2,000
700	2,000 to 4,000
500	4,000 to 8,000
400	8,000 to 12,000
350	12,000 to 16,000
300	16,000 to 22,000

Many spiral fans are incorrectly designed. They may, for instance, throttle the air at the spiral, though this fault is not to be found in modern fans; they may have too much clearance at the point where the impeller enters the spiral, and so may readmit an excessive quantity of air at that point; the flare of the chimney may be excessive, though sometimes it may be insufficient; flanges may project in the casing and pedestals to hold the impeller or mechanism to turn it may interfere with the free flow of air, create turbulence and prevent economical operation.

However, a fan, no matter how efficient, may fail to give good service if it does not fit the mine it is ventilating. A fan may deliver a certain definite quantity of air in cubic feet per minute at a certain water gage but, if the mine will not pass that quantity of air with that difference of pressure, the workings will not receive it. In fact, no mine is ventilated by a fan. The fan merely provides a definite quantity of air at a certain pressure, and the mine passes as much of it as it is capable of passing at that pressure.

A mine will soon outgrow its mine fan, unless means are taken to bring in air from another point. If the pillars are left in and these are later taken out on retreat, the fan of the mine's earlier years, or one like it, may be found again well suited to its needs.

By speeding the fan, or by slowing it, the right quantity of air may be delivered at a higher or lower pressure, but a fan does its best work with a certain definite range of speed, so there is inefficiency within the fan itself if it is speeded or slowed beyond that limit.

It is profitable, therefore, in such cases to provide another fan. However, it may be possible and profitable to move in a fan from another mine to which it is unsuited, if it has characteristics to suit those of the mine to be ventilated; and some companies with many mines thus move their fans around. In each case it must be determined whether the losses being sustained would justify buying a new fan or moving an old one. Some fans have a larger range of suitable speeds than others and, therefore, can be used with less loss of efficiency as the mine grows than other fans.

Resistance of airways depends on the speed of the air. The adjacent valuable table of limiting speeds of travel has been prepared by the American Mining Congress for a standard of the Engineering Standards Committee (now the American Standards Association). Presumably, the higher figure is the limit for shafts, and the lower for other airways, where more leeway is obtainable.

In roadways having an air speed of 1,500 or more feet per minute, effort should be made to increase the size of the opening, to avoid turns, to support the roof and sidewalls, so that there will be no falls to vary the cross-section, to coat the surfaces so as to eliminate roughness, to exclude travel of cars and persons and to split the air as soon as possible, so that the high velocity will be for only a short distance.

Too often the roof is allowed to get in bad condition before measures are taken to prevent it. It is where air first enters the mine that it is most destructive to the roof. It drives and wets the rock, it expands and sometimes freezes it, and so causes rapid deterioration just where such a condition renders the air most turbulent.

Arch Supports Reduce Friction

However, after rock has fallen, arches can be used to protect the roof—either semicircular, segmental or "covered-wagon" arches. Semicircular and segmental arches have been used very satisfactorily in two anthracite mines and "covered-wagon" arches in Maryland. They are of such shapes that they may safely be made of small cross-section. Thus they keep the dimensions of the airway symmetrical and almost intact. Where the roof does not tend to yield—and it rarely does near the shaft—the walls, room and arches can be coated with cement mortar so as to make a passage of low resistance.

Shafts should be lined. To keep the intake shaft from freezing in the winter, the air may be warmed to prevent the formation of ice, which would otherwise fill the shaft and airways, and to protect the shaft walls and linings. Thus protected against freezing, vanes can be put in the top and bottom of the

shaft, which will enable the air to make the needed turns and to make any expansions or contractions desired with minimum turbulence and power loss.

In the main airways also, it is desirable that steel arches of new material or discarded rail be used instead of timber, which causes much turbulence. These arches will yield a little—enough to enable the measures to arch and take the weight that falls on the heading. If the roof is to carry the weight, it naturally will be said, why use arches at all? Unfortunately, while the roof is preparing to meet the load, drawslates become broken and will fall if nothing is provided to hold them in place. This will leave yawning caves into which the air will expand with turbulence. Moreover, the drawslate becomes dangerous and has to be supported, so it is best to support it early if it is likely that such protection will be needed eventually.

In this way, arches or timbers save much maintenance later, and if the roof bleeds methane, no place is left in which it may accumulate. In most American mines, except where longwall is used or a squeeze starts, rarely would arches need to be removed and straightened. They would last as long as the mine and probably could be used again. Being of light cross-section, they would not be expensive.

Eliminating Stoppings

By arranging that air shall be carried into the mine by two or more adjacent intakes and returned by two or more adjacent returns, permanent stoppings can be largely eliminated, for the pillar between the intake and return can be kept almost free of crosscuts. This pillar should be wide enough that air will not leak through it. Pillars will often pass water, and when the water leaves will pass air through the same crevices. Pyrite will oxidize and the sulphate formed will enlarge crevices and in dissolving will pass out, leaving openings through which air will pass freely. Expansion of carbonates on sulphatization will tear pillars apart; strains will open them up; and heavy shooting will crevice pillars for perhaps 15 ft. or more. So the central pillar should not be too small. Rock-dusting will close many of these crevices, forming with sulphatic waters a more or less impervious scum. Thus rock-dusting will prevent leakage in pillars.

With two intakes, where haulage is on the intake, as it always should be, air can bypass trips which would otherwise unduly restrict the passageway and raise air resistance. The same is true where the haulage is in the return. Care should be taken to keep returns free from gob or fallen rock. Where coal is low, miners lifting bottom or breaking down top in rooms which pass across return airways often pile the rock thus obtained in airways, and in this way greatly increase air resistance. However, expense should not be incurred to remove fallen or other rock from airways if the only effect is to relieve them of so much resistance that, after removal, regulators will have to be placed to prevent them from taking too large a proportion of the air current.

Headings should be driven straight and of uniform cross-section, because irregularities in the airway are conducive to increased resistance. Where a long room entry has to be driven, and air for the entry cannot be obtained from any other source than the main air current, care should be taken to put an extra intake or return airway to keep the resistance of this entry equal to that of other entries or it will receive less air, whereas it usually should receive more, because, in a gassy mine, it has more opportunities for vitiation by methane and, in all mines, of vitiation by explosive fumes and carbon dioxide. This matter should be considered before the entry is started. If it is overlooked, either the main fan will have to afford the entry the needed air pressure or a booster fan will be required. If the pressure is supplied to this entry by the main fan, the pressure on the whole mine will have to be increased and regulator losses will be suffered at all other entries—a most wasteful procedure. If a booster is used, an element of danger is introduced; costs for installation, operation and maintenance are added. Thus, from the first, provision should be made for suitable airways.

How to Make Turns

Where right-angled or sharp turns must be made in the travel of the air, the inner and outer angles of the turn should be curved, if that can be done. Curved vanes for turns have not been found helpful by the U. S. Bureau of Mines, and doubt has been thrown on all such vanes for that reason, but the experiments were not made at very high speeds of travel, and tests made of air in ducts at such high speeds have shown that curved vanes reduce resistance. At usual speeds in headings, they are not desirable and should not be installed.

In earlier years, with oil or sunshine lamps, a ready means was available for testing brattices. The flame could be held against the brattice and would be drawn through crevices, revealing leakage. Today, with acetylene and electric lamps, stoppings cannot thus be tested, and the stout and otherwise well-built stoppings at many a mine doubtless leak around the edges and at cracked mortar joints. Stoppings should be sunk into floor and ribs, and their joints should be well pointed shortly after their completion. Cement mortar plastered or sprayed on the coal and on the roof near the stopping will prevent much air from slipping past the edges of the stopping, especially where the water gage between intake and return is considerable, as it usually is, near a shaft, slope, drift mouth or booster fan. Losses at manway doors could be lessened if a revolving door were used, but it should be set in a satisfactory frame or it will bind under roof weight.

Recirculation of air is a danger almost never considered but very real. A suction fan will drag air through cracks in the ground into the vacuities around the shaft and thence into the shaft itself if not properly lined. With a force fan, some of the air will leave the mine around the shaft mouth via similar vacuities that lead to the surface. Just how much air at any mine is thus leaking in or out is not generally known, because conditions do not favor examination when the fan is running. The same is true of fan drifts and fan slopes. Of course, the other outlets of the mine can leak around their orifices at their pleasure, unless they are supposed to be stopped, in which case it is best to erect the stopping at a point remote from the orifice.

Recirculating Mine Air

A few years back, several persons were asphyxiated in Belgium by waste industrial gases in a valley over which hung a pall of fog. All this shows how methane, even though light, might be held over a return from a mine and not promptly dissipated. With the near-by intake drawing heavily, this methane-laden air may be drawn in part back into the mine, to say nothing as to other gases. Conditions are most favorable for such a condition where intake and exhaust travel in the same shaft or even with separate shafts where the air is taken to, and drawn from, a narrow valley with steep hills on either side, with vegetation and fog to hold down rising air currents, or with wind traveling toward the intake from the return. The cure for the condition when discovered is either a surface tunnel for the intake or a large chimney for the return, provided a new shaft for the air current is out of the question. More important than air quantity is air quality, and those who are making sacrifices to obtain a low methane percentage in the return would do well to see if there is a low methane percentage in the intake.

Ventilation costs are so large that they should be carefully watched. Increased tonnage per hour due to a shorter day, where established, involves a greater breaking of coal per hour and will increase the volume of methane emitted, and, in mines shooting during working hours, will increase the volume of smoke also, so more ventilation will be required. Moreover, if miners are to be relieved of the hampering effect of smoke and are to work safely, yet continuously, in a mine generating methane, they will need more air, unless an excess is already supplied.

COAL SPENDS

+ Over $575,000,000 in 1933

PROBABLY reflecting the exhaustion of reserves and the end of salvaging operations, per-ton expenditures for materials and supplies by the anthracite and bituminous industries turned upward in 1933. This upward trend, coupled with the increased output of soft coal, carried the total outlay for materials and supplies by both industries to $69,693,950 last year, against the revised total of $63,420,160 in 1932. These figures exclude all charges to the capital account for permanent additions, improvements and betterments, as well as purchased power, explosives and wages.

Estimated total expenditures for power and wages, however, declined in 1933, reflecting a decrease in per-ton expenditures due to greater efficiency and, in a number of soft-coal regions, to wage decreases which were not entirely wiped out until the adoption of the code. In the old bituminous union fields, reductions were granted in contracts in 1932, and the lower rates continued throughout 1933 without change. Mine workers, it is estimated, received more than $393,900,000 in 1933, as compared with $411,900,000 in 1932, while payments for purchased power aggregated more than $27,400,000, against $32,000,000 in the preceding year. Together with payments for merchandise for resale at company stores and expenditures for permanent additions, improvements and betterments (which increased sharply last year), outlays for materials and supplies, purchased power and wages were sufficient to bring the buying power of the anthracite and bituminous industries up to more than $575,000,000 in 1933, approximately the same as the 1932 figure.

Data collected by *Coal Age* indicate that the total expenditures for materials and supplies by bituminous producers were over $50,900,000 in 1933. Reduced to a per-ton basis, these averaged 15.5c., against the revised *Coal Age* figure of 14.5c. for 1932 and the average of 20c. determined by the U. S. Bureau of Census in 1929. The *Coal Age* figure for 1929 was 20.5c.

The anthracite industry, according to the survey, spent more than $18,800,000 in 1933 for materials and supplies. Expenditures per net ton in 1933 were 38c., against 36.5c. in the preceding year. The Census figure for 1929 was 58c.

Returns were received in the 1933 survey from all but two of the major coal-producing States of the country, although in some instances they were not sufficiently complete for inclusion in the accompanying table. These returns covered both captive and commercial operations, with a preponderance of reports from the latter. The bituminous estimate of 15.5c. was arrived at by weighting the totals for each State separately on the basis of actual reports from operators and the estimated output for each State during the past year. Using the preliminary figure of 327,940,000 net tons for 1933, this weighting gave $50,922,130 as the total expenditures for materials and supplies. Totals for purchased power and wages were arrived at in a similar manner.

Of the returns received which gave data with sufficient detail for inclusion in the general compilation, 2.6 per cent were from companies producing less than 10,000 tons in 1933; 13.5 per cent from companies producing 10,000 to 50,000 tons; 14.7 per cent from companies producing from 50,000 to 100,000 tons; 22.4 per cent from companies producing from 100,000 to 200,000 tons; 26.2 per cent from companies producing 200,000 to 500,000 tons; 9.6 per cent from companies producing from 500,000 to 1,000,000 tons; 8.4 per cent from companies producing from 1,000,000 to 2,500,000 tons; and 2.6 per cent from companies producing over 2,500,000 tons.

Expenditures for Materials and Supplies by Coal Mines in 1933

	1933 Estimated Expenditures for Materials and Supplies			1932 Estimated Expenditures for Materials and Supplies			1929 Actual Expenditures for Materials and Supplies		
	Production, Net Tons	Average per Ton, Cents*	Total for State**	Production, Net Tons	Average per Ton, Cents*	Total for State**	Production, Net Tons	Average per Ton, Cents	Total for State
Alabama	8,775,000	15.5	$1,360,125	7,857,000	16.5	$1,296,405	18,189,453	30.0	$5,449,568
Colorado	5,211,000	28.5	1,485,135	5,599,000	22.5	1,259,775	9,832,839	26.5	2,616,787
Illinois	36,110,000	18.0	6,499,800	33,475,000	14.0	4,686,500	60,705,123	20.0	12,115,662
Indiana	13,500,000	19.0	2,565,000	13,324,000	15.5	2,065,220	18,624,508	20.0	3,718,903
Kentucky	35,530,000	15.0	5,329,500	35,300,000	14.0	4,942,000	60,894,039	18.0	10,923,814
Maryland	1,500,000	14.5	217,500	1,429,000	16.0	228,640	2,638,216	20.5	540,026
Missouri	†	16.5	†	4,070,000	13.0	529,100	3,963,458	29.0	1,145,658
Montana	2,130,000	10.0	213,000	2,125,000	15.0	318,750	3,442,518	33.5	813,641
New Mexico	1,160,000	43.0	498,800	1,263,000	32.5	410,475	2,631,512	32.5	859,312
Ohio	19,960,000	14.5	2,894,200	13,909,000	11.0	1,529,990	24,091,756	16.0	3,894,114
Pennsylvania	79,770,000	16.0	12,763,200	74,776,000	15.0	11,216,400	144,111,440	19.5	27,914,503
Tennessee	3,570,000	14.0	499,800	3,538,000	10.5	371,490	5,405,023	14.5	785,744
Virginia	8,390,000	14.0	1,174,600	7,692,000	11.5	884,580	12,745,100	20.0	2,564,208
West Virginia	90,770,000	13.0	11,800,100	85,609,000	14.5	12,413,305	139,031,657	17.5	24,293,487
Wyoming	3,965,000	22.5	896,625	4,171,000	19.5	813,345	6,700,272	26.0	1,750,139
United States Totals	327,940,000‡	15.5	$50,922,130‡	309,710,000‡	14.5	$45,223,085‡	537,442,495‡	20.0	$106,438,396‡
Pennsylvania anthracite	49,399,000	38.0	$18,771,620	49,855,000	36.5	$18,197,075	74,545,900	58.0	$43,367,491

*Average derived from actual figures submitted to *Coal Age* by operators.
**Production multiplied by average expenditure per ton.
†Estimate included in United States totals.
‡Including other coal-producing States not specifically shown.

NOTES

. . . from Across the Sea

SUSPENDED solids settle more speedily in alkaline waters than in acid or neutral waters. The water should have a pH value of 11, declared R. D. Gifford, president, Midland Section, Junior Institution of Engineers, at least when potato starch is used, as in Belgium, in a process for water clarification developed by R. A. Henry, who is in charge of a group of Belgian collieries. When the starch is frozen, it gives the best service; alkalinity is assured by adding both lime and caustic soda. Best results are obtained in his practice with 8 oz. of lime, 0.22 oz. of starch and 0.45 oz. of sodium hydroxide per short ton, but one would suppose more lime and sodium hydroxide would be needed in most of the United States washery waters, because of their greater acidity. However, as they have less clay, perhaps less depressants may serve for clarification.

Lime water makes suspended clay sticky, so that it adheres to the slate particles or dirt, which are colloidal, but it does not adhere to the coal, which is not of that nature. As much of the clay settles before it reaches the cone in which the fine coal is collected, the final refuse is cleaner than it would be if all of it settled in the cone. The product, therefore, may well be, in many cases, clean enough for colliery boiler plants. In fact, it is thus being used. Some experiments along this line have been made in the United States and in Germany, according to our advices. Herr Petersen, of the Freiberg Bergakademie, has shown that the addition of 0.4 to 6.68 oz. of potato starch per 1,000 gal. of water is helpful, the quantity used depending on the quantity of slime in the water. Herr Petersen, however, uses hot starch—a 2-per cent solution at 194 deg. F. Several coal-washing plants in the Ruhr district have had good results with this clarification agent.

FOR some reason, water wets most substances more readily than carbonaceous materials like coal and experiments made in England have sought a method of increasing this dust-wetting quality of water. These experiments were described in a paper by F. V. Tideswell and R. V. Wheeler, before the Midland Institute of Mining Engineers, in session at Leeds. The authors declared that though it was difficult to wet coal dust, as required, so that it would always be combined throughout with 30 per cent by weight of water in intimate mixture, it might be possible to do so by the use of "wetting agents"—substances which, added in small proportion to water or other liquid, will enable it to wet materials that without it could not be wetted or would be wetted very slowly.

Two such agents, manufactured by the Dyestuffs Groups of the Imperial Chemical Industries, Ltd., used in the textile industry and known as Perminal and D.S. 103, were tested. The dusts to be treated were spread in an even layer in trays, and the solution of these agents was applied with a paint sprayer operated by compressed air. Only 1 per cent solution of either wetting agent was needed. Water sprayed on coal dust —85 per cent of which had passed through a 200-mesh screen—formed big drops and refused to wet the mass. Paraffin, on the other hand, formed a sludge, which became cracked like dried mud. When the water containing the wetting agents in 1 per cent solution was applied, the dust became a dense sludge with a surface resembling one of those small scale relief maps used to visualize a hilly country. True, the water was not promptly absorbed, but in a half hour it had disappeared. When a weight of solution equal to the weight of coal dust was sprayed on the latter, a true sludge was formed. Coarser dust (40 per cent through a 200-mesh sieve) was wetted more easily. The lower the carbon content, the more readily it absorbed water.

All this appears expensive, even though the wetting agents are said to be cheap, but it has been found that fresh coal dropped on the wetted deposit binds itself to it and is readily wetted by further application of water; in fact, water can be added effectually six or seven times, because the agent readily dissolves in the added water.

The Explosions in Mines Committee of the British Home Office reported in 1914, say the authors, that the larger the quantity of incombustible dust, the smaller the quantity of water needed to render a mixture of incombustible dust and coal dust incapable of propagating flame. Coal dust containing up to 15 per cent of inert material must be wetted with between 25 and 30 per cent of water if flame propagation is to be prevented. Every additional 10 per cent of inert material reduces the water required by about 5 per cent. This committee declared that watering and rock-dusting is preferable to either alone.

Unfortunately, rock dust and coal dust are rarely well mixed. There always will be places relatively rich in coal dust. This causes a differential wetting action which a wetting agent would prevent. The authors of the paper suggested using solutions of wetting agents in operating water-fed drills, and in spraying around shotholes, at conveyor ends and on rock-dusted traveling roads, in cases where water may be used without detriment. Using such agents, free water, which always is objectionable, would not accumulate. The authors did not advocate the use of this treated water on the ribs of headings, because limestone and other white dusts not only prevent explosions but improve lighting.

In discussion, Prof. Douglas Hay declared that in wet drilling, water wets only the coarser dusts, the very fine dust being blown out of the drill. It is this fine dust that is most injurious to the lungs of the driller. It was stated that the wetting agents used are neither acid nor alkaline, are not poisonous or in themselves corrosive—that is, they do not add to the corrosive quality of water. How they would be affected by mixing them with hard mine waters has not been determined. Perhaps a coarser whitewash spray might be used effectually in place of a fine paint spray.

The odor of the wetting agents is unpleasant, but apparently the mist from them was not injurious when inhaled. However, Dr. Wheeler thought it should not be breathed, and, once the mist settled on the floor, such inhalation was impossible. Its effect on cuts has not yet been considered. J. W. McTrusty suggested putting a screen behind a cutting machine in the hope that the screen, wetted with a larger percentage of wetting agent than suggested, would in turn wet the dust and cause it to be deposited. Dr. Tideswell declared that a higher percentage of wetting agent than 1 per cent should perhaps be used at conveyor ends.

In comment, it may be said that such a solution sprayed on the face or on the recently shot coal, would not increase the ash in the coal or spoil the appearance of the product as limestone does. Such effects, however, are not objectionable where the coal is to be used for metallurgical coke. Inquiries as to the use of such wetting agents in the textile industry of this country revealed that such agents were used in bleaching and scouring textiles.

ENLARGEMENTS and contractions of an airway are extremely obstructive to the air current and were discussed in a paper presented at the same meeting by W. E. Cooke and I. C. F. Statham, who had been making experiments at the University of Sheffield. Unfortunately, in all cases they made the enlargements and contractions equal in four directions, two vertical and two horizontal, whereas in practice a heading usually becomes only higher or wider, a variation in one direction at a time. The ducts were all square, and current speeds were quite high, some being 2,880 ft. per minute, velocities likely to cause much turbulence. To reduce eddying to a minimum at the enlargement or contraction, straight pipe

was provided, at the approach to the change in cross-section, of length equal to three or four times the width of the duct. Beyond the change, the length of straight pipe was twelve times that of the width of the cross-section.

The authors declared that the resistance of an enlargement or contraction (1) varies directly as the square of the quantity of air passing, (2) is reduced 24 per cent if the enlargement is made at an angle of 15 deg. and 65 per cent if made at an angle of 7 deg., (3) is reduced 75 per cent if the angle of contraction is 15 deg. and 85 per cent if it is 7 deg. The authors added that the percentage saving decreases as the ratio between the areas of the sections decreases and that, for angles below 15 deg., resistance of an enlargement increases almost directly as the angle increases. Above 15 deg., however, the angle has little influence. This does not apply to contractions. There, resistance increases almost directly as the angle increases.

For sudden enlargements, resistance augments almost in proportion to the ratio of the larger to the smaller diameter. For sudden contractions, resistance increases considerably as the ratio of the larger to the smaller duct is increased. The authors conclude that it would not be profitable to taper offsets ("lips or canches").

They fail, however, to refer to the lessened danger to travelers along roads where all offsets are tapered gradually.

R. Dawson Hall

On the ENGINEER'S BOOK SHELF

Requests for U. S. Bureau of Mines publications should be sent to Superintendent of Documents, Government Printing Office, Washington, D. C., accompanied by cash or money order; stamps and personal checks not accepted. Orders for other books and pamphlets reviewed in this department should be addressed to the individual publishers, as shown, whose name and address in each case is in the review notice.

Report on the Medical Treatment of Men Burned in Colliery Explosions. British Mines Department, British Library of Information, New York; 28 pp. Price, 17c.

Covering mine and hospital treatment of burns incurred at mines, this brochure declares that dry picric-acid dressings should be used over exposed burns as soon as possible. Carron and other oils interfere with subsequent treatment by tannic acid and tend to infect the wound. With extensive burns there may be shock immediately after injury, probably due to action on the nerves. Shock, however, may be experienced after 3 to 6 hours, due to fall of blood pressure and decreased volume of circulating blood, resulting in an inadequate supply of oxygen. This is more serious than primary shock. A third stage is reached at the end of the first week, when bacteria may invade the dead tissues and zone of repair.

Hospital treatment recommended comprises preparation of the injured surfaces for coagulation, accompanied by general anæsthesia with nitrous oxide and oxygen (4 or less to 1)—not ether, which is a depressant—also 3 to 4 per cer cent of carbon dioxide; coagulation of tissues with a 20-per cent solution of tannic acid plus a 1:1,000 solution of acriflavine; intravenous injection of a colloidal solution of correct concentration, such as blood or gum acacia, if the blood pressure is low; and inhalation of carbon dioxide and air. Fuller details, of course, are given. This booklet should be helpful to the medical staffs of coal mines, and was prepared because, in seven recent explosions in Great Britain, 45 persons who were recovered alive after explosions died in the hospital and only 17 survived.

Maintenance of Electrical Mine Equipment From the Viewpoint of the Safety Inspector, by E. J. Gleim and H. B. Freeman. U. S. Bureau of Mines, Technical Paper 537. Price 5c.

This admirable monograph points out the defects in permissible machines as operated at 50 mines. Leading defects were: (1) Missing or loose bolts; (2) open joints in explosion-proof inclosures; (3) unvulcanized splices in trailing cables; (4) locks and seals missing, broken, or rusted open; (5) trailing cable unprotected by fused trolley tap. It appears that most of the failures were in the connections between the machine and the trolley line, though some were defects of the permissible equipment itself, as note (1), (2) and (4) of the defects listed above.

A questionnaire for inspectors included in the paper contains 34 separate inquiries, with reasons for their pertinency. All dangers are exhaustively treated. A permissible machine is safe equipment only if kept in proper repair. Too often it is not thus kept. It is distressing to find that in 50 mines bolts were found missing or loose, the bolts being intended to make joints tight enough to prevent escape of flame within the machine.

Compressibility and Bearing Strength of Coal in Place: Tests of Lateral Compression of Pittsburgh Coal Bed, by H. P. Greenwald, S. Avis and G. S. Rice. U. S. Bureau of Mines, Technical Paper 527; 12 pp.

Coal has a greater compressibility, both vertically and laterally, declares this publication, than most construction materials. It takes a permanent set which is roughly 60 per cent of the total deflection. Additional cycles of pressure and release, even though kept strictly within initial and maximum pressures of the first compression cycle, yield successively smaller increments of total compression and permanent set, provided that the first maximum does not exceed the bearing strength of the coal. Increasing the pressure beyond the maximum reached in the first compression causes additional permanent set, and the rate of deflection of the loaded surface increases steadily until the coal fails by crushing, deformation or flowage.

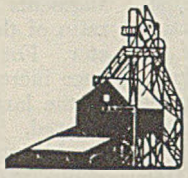
The surface surrounding the loaded area is deflected only fractionally as compared with the loaded area, because the two areas are not continuous, the coal shearing around the perimeter of the compressing block. Absolute deflection at a given distance from the edge of the compressed area increases with the size of that area and decreases with increasing distance from the edge of an area of any given size. The coal face gives measurable deflections at a distance of possibly 5 ft. from the area where that area is 200 sq.in.

Deflection of the surrounding surface is in the direction of the applied load and is proportional to the increasing pressure, but only for a small range of pressure; thereafter it decreases steadily, and even in some cases reverses in direction. Permanent set at the end of the first cycle is positive near the compressed area, but further away it is negative—that is, in a direction opposite to the applied load. Succeeding cycles of pressure resulted at all points in decreased deflection of surrounding areas and decreased also the permanent set in those areas. But, as in direct compression, stable conditions seem likely to be approached with an increasing number of cycles.

Bearing strength decreases as the size of the compressed area increases, but tends to approach a constant value for large areas, which, under the conditions of test in the Pittsburgh bed, is about 4,000 lb. per square inch.

Tests were made with a hydraulic jack of 500-ton capacity and on five areas, ranging from 25 to 200 sq.in. The surfaces were vertical and smoothed with an 8-in. Carborundum wheel mounted on the shaft of a motor. The jack and accessories weighed almost 2 tons and were tested by U. S. Bureau of Standards. Movements of 0.0001 in. could be estimated, though the dial gages were graduated to only 0.001 in. The cover over the coal seam, tested by these experiments, varied from 70 to 80 ft.—R. Dawson Hall.

OPERATING IDEAS



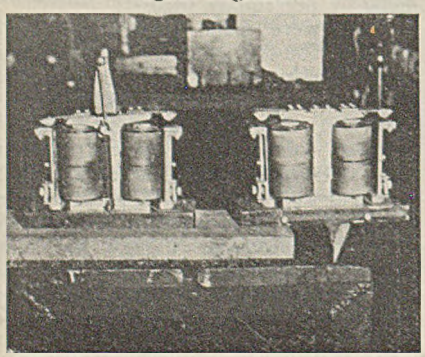
From Production, Electrical and Mechanical Men

Modified Reel Switches Put to Use In Automatic Signal System

ONLY an exceedingly elaborate and costly track-signal system can be fully automatic and also protect against every conceivable circumstance, including open circuits and other defects that may arise in the relays or other electrical parts. Even if a system of that type were installed, there still would remain the slight chance that the motorman would fail to observe the signals correctly. This is illustrated by the adoption of automatic train stops in connection with track signals on certain railroads. Every feature added to protect against remote but possible conditions increases the cost of the installation and therefore few if any of the coal-mine-haulage signal systems that have been installed embody all of the protective features included in railroad signal systems.

If that feature protecting against simultaneous entrance of two locomotives into the same block is dispensed with, the automatic signal becomes relatively simple and inexpensive. When it is considered that "simultaneous entrance" means entrance of the locomotive trolley wheels into the trolley contactor devices within a small fraction of a second of each other, and that the possibility of this happening is very slight, this type of signal system appears justified on hauls which are not too fast and crooked, especially if the haul has previously been operated without signals or possibly with flagmen. It has been demonstrated that flagmen are far from being 100 per cent reliable.

Fig. 1—Left, Rebuilt Switch; Right, Original.



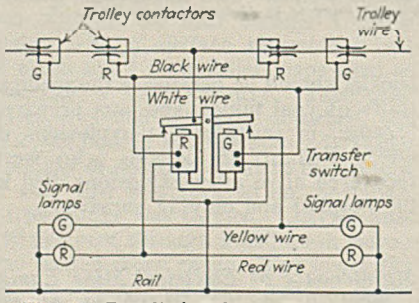


Fig. 2—Detailed Wiring Diagram of Simplified Block.

An example of this simple type of automatic signal recently went into operation on an outside haul at Junior mine, Howard Collieries, Norfolk & Western Ry. fuel department, Chattaroy, W. Va. Relays were built from automatic transfer switches available at the mine, and the other items, such as trolley contactors and signal lamp boxes, were made in the mine shop.

The switches utilized are the standard Jeffrey Mfg. Co. type for use on gathering locomotives and designed to establish automatically the circuit through trolley or cable reel as either is connected to the power. It was necessary to add a spring toggle to hold the armature in either position after being shifted to that position by the action of the corresponding coil. When in normal use on a locomotive, the coil is kept energized to hold the desired position. As used in the signal sytem, the coil is energized only while the locomotive trolley wheel is passing through the contactor device. Fig. 1, right and left, respectively, shows the transfer switch before and after adding the spring toggle. Another change was to disconnect the coil leads from the contact terminals.

Fig. 2 shows the connection details of a block of track with two entrances. As the transfer switch stands, there is a locomotive in the block and the red lamps are lighted. As that locomotive passes out of the block it first goes through an "R" (Red) contactor. When this happens the trolley wheel momentarily connects the "black wire" to the trolley, thus energizing the "R" coil. But the

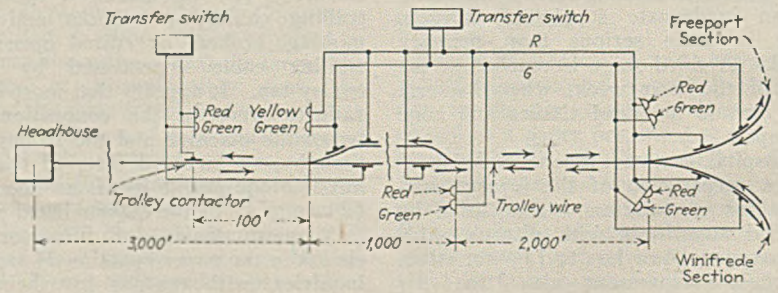


Fig. 3—Schematic Diagram, Junior Signal System.

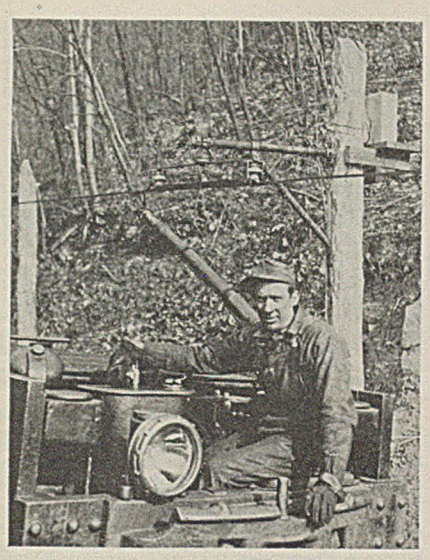
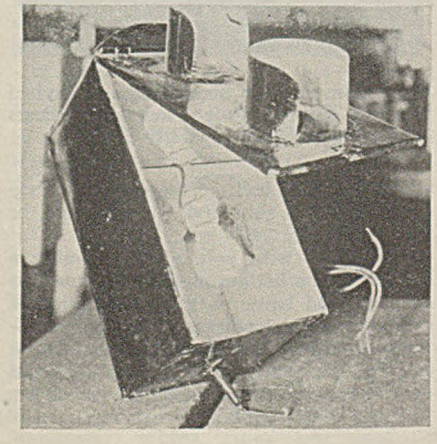


Fig. 4—Main Haulage Locomotive Going Through a Trolley Contactor.

transfer switch armature is already in this position, so nothing happens. But as the locomotive passes through the "G" contactor when leaving the block, the "white wire" is connected to the trolley, and thus the "G" coil is energized, with the result that the red lamps are switched out and the green lamps are lighted, thus indicating a clear block. The reverse is true as a locomotive enters a block. The green lamps already are lighted, so no change takes place when the trolley wheel goes through the "G" contactor. But in this case as it passes through the "R" contactor, the switch changes position, switching out the green lamps and lighting the red.

It will be observed in Fig. 2 that it is necessary to carry four bus wires parallel to the tracks. As many contactors and signal lamp boxes may be added as there are entrances to the block, and these added contactors and lamps are connected to the same respective bus wires, thus putting all contactors of a class and all lamps of a color in parallel. In the actual installation, wires colored black, white, yellow and red are used. Therefore it is unnecessary for electricians to trace out wires when "shooting trouble"; and in case of a wreck or other accident that may break several signal wires, unskilled help can put the system back into temporary order by splicing wires of like color.

Fig. 5—Showing Construction of a Signal Box With Spring Latch on Bottom.



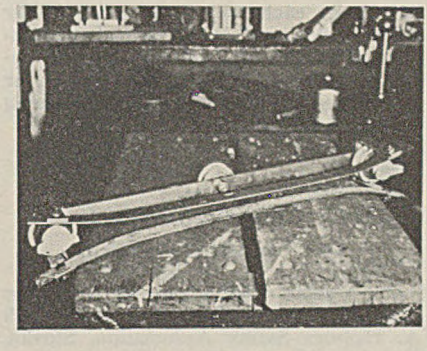


Fig. 6—Shop View of Trolley Contactor Fully Assembled.

Fig. 3 is a schematic one-line diagram of the Junior signal system as installed on the outside portion of the main haul. Arrows pointing toward the headhouse indicate direction of loaded trips and the reverse indicates empty trips. On this schematic diagram, a trolley contactor shown connected to an "R" bus simply indicates that the contactor is one which, if traversed by the trolley wheel, will light the red lamps and darken the green.

This diagram shows two blocks, one 3,000 ft. long from headhouse to passing tracks and the other the same length, including the sidetrack and extending to the junction leading to the two main sections of the mine. At the left end of the passing tracks, a yellow signal is substituted for the red in the "R" circuit. This is a warning signal to the empty trip approaching from the headhouse section that a trip is in the next section and that the empty trip should proceed onto the sidetrack with caution, there to await clearing of the next block or appearance or passing of the approaching loaded trip, if that be the case.

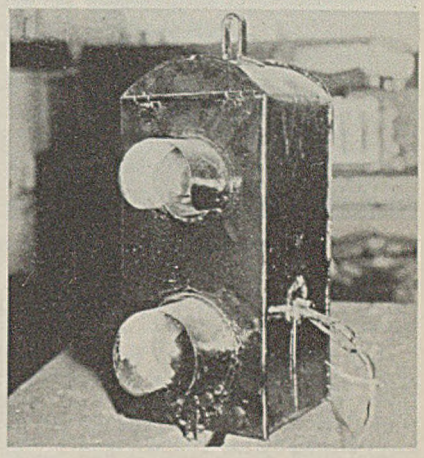


Fig. 7—Signal Box Uses Colored Lenses and Has Hanger Eye on Top.

In the halftone, Fig. 4, the trolley wheel is about to enter a contactor. On the trolley post is the metal case housing the transfer switch that operates that block.

The trolley contactors (Fig. 6) were made up in the mine shop. The top bar is $\frac{3}{8}$x1$\frac{1}{2}$ in., the end supports $\frac{1}{4}$x1$\frac{1}{2}$ in., and the contact, or wearing strips, $\frac{1}{4}$x1$\frac{1}{2}$ in. All are made of ordinary soft steel. Over-all length is 36 in. and the width across end openings between contact strips is 5 in.

Signal boxes (Figs. 5 and 7) also were made in the mine shop from No. 18 galvanized steel. Colored lenses of standard type are used. Each box is equipped with hanger eye, lens shades and spring door fastener. Lamps are mounted on top and bottom sides of a piece of wood which forms the partition.

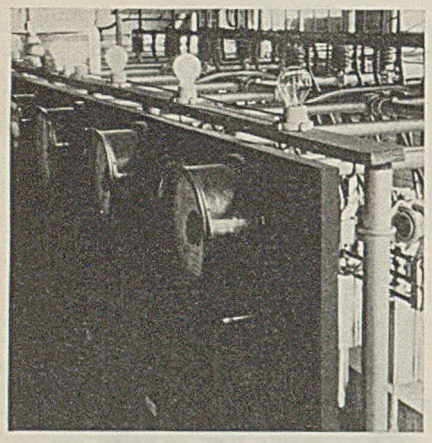
The signal circuit and parts employed were designed by T. V. Maynard, chief electrician.

Up to the Man At the Mine

The seven-hour day and higher wage scales now in effect in the bituminous industry put still greater pressure behind the drive for lower costs and higher efficiency. The greater part of the burden of putting into effect the measures that undoubtedly will be adopted to meet these new conditions naturally will fall on operating, electrical, mechanical and safety men at the mine. Consequently, knowledge of the cheapest and most efficient method of meeting both routine problems and unexpected emergencies will be even more essential than in the past, and likewise the benefits of an interchange of experience will be enhanced. Here, in these pages, you will find each month a selected list of items bearing on efficiency and cost reduction and here is where the ideas you have evolved belong. Send them in, and gain not only the credit but also a cash return of $5 or more for each that is acceptable.

Connected Loads Indicated By Lamps Above Panels

When starting a power plant after a shutdown and when shifting the load from one generating unit to another it may be a distinct operating advantage to be able to determine at a glance just what loads or circuits are connected at the time. This is especially true when two or more principal loads are served from some of the power-plant panels, as is the case at the recently improved



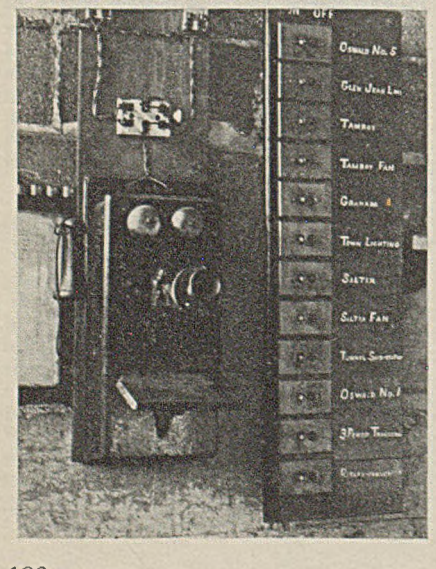
One Lamp for Each Principal Load.

power plant of the McKell Coal & Coke Co., Kilsyth, W. Va.

Here a single lamp has been mounted above each panel serving a major load; above the other panels, two or more lamps are mounted, depending on the loads served by each. Each lamp is controlled by a pushbutton switch properly labeled and mounted on a board beside the mine telephone, which is situated near the power-plant switchboard. As the shift engineer communicates with the load centers and is notified that certain loads are connected or cut off, he changes the corresponding pushbutton switch to indicate the condition by the lighted or unlighted lamp over the feeder panel.

In the photograph of the upper corner of the switchboard, the lamp at the right is not lighted, indicating that the principal load of this first panel is not connected. All other lamps are lighted, indicating connected loads on the other panels. Referring to the photograph of the board beside the telephone, it will be noted that the words "ON" and "OFF" are marked above the corresponding positions of the pushbutton switch, even though the "ON"

Lamp Control Board.



button of each switch is indicated by white color. This additional precaution is an example of forethought designed to lessen the chance of a new or substitute shift engineer becoming confused.

Safety Council Adopts Code For Cutter Operation

After more than a year of work, the Nairn Callaghan Council of the Joseph A. Holmes Safety Association, Slovan, Pa., has adopted a set of standards to govern the work of machine crews and the operation of cutting machines. The text of the code is as follows:

CODE OF STANDARDS FOR MACHINE RUNNERS AND SCRAPERS

1. It shall be the duty of the machine runner to keep his machine in repair and well lubricated. Mechanical defects which the machine runner cannot himself repair shall be reported at once to the machine boss or mine electrician.

2. It shall be the duty of the machine runner to see that all bolts, cover plates, fuses and cables are in good condition before starting the shift. If the machine is found defective in any way that would jeopardize his safety he shall not start same until the defect is remedied.

3. It shall be the duty of the machine runner to take every precaution to prevent injury to his machine from falls of roof or rib.

4. Machine runners are positively required to reset all timbers knocked out by them.

5. In cutting wide places the undermined coal shall be blocked or spragged at distances not exceeding 7 ft. apart; also in narrow places where clay veins or spars are present.

6. No one except the machine runner is allowed to ride upon the mining machine at any time.

7. In order to prevent injury to the machine runner by reason of insecure position of machine jack, the scraper is instructed to hold the jack in position, and the machine runner is advised to see that the scraper observes this precaution until the runner has moved to a position where the jack in falling will not injure him.

8. Machine runners and scapers are instructed to guard against the swinging of the mining machine when the jacks are tightening at the time the machine starts cutting.

9. No employee shall cross over the cutter bar of the mining machine at any time, but must pass around the rear of the machine. Also no employee shall pass any tool or other material across the cutter bar while the chain is in motion.

10. The machine runner shall remain at the rear of the mining machine at all times, as nearly as practicable, while it is cutting coal and must remain at the control of the machine until it is sumped in.

11. Mining machines shall be stopped before jacks are changed.

12. The machine runner shall see that the bit clutch is not engaged while changing bits.

13. When the machine is traveling from one place to another the scraper shall travel at least 50 ft. in advance of the machine.

14. A safety chain or keeper should be kept on the cutter bar when the machine is not cutting.

15. Machine runners must see that the machine bits are at all times set to gage. Dull bits should be changed as required.

MINING LAWS TO BE OBSERVED IN GASEOUS MINES IN PENNSYLVANIA

16. Each trailing cable in use shall be examined daily by the machine runner for abrasions and other defects, and he shall also be required to carefully observe the trailing cable while in use, and shall at once report any defect to the person in charge of electrical equipment.

17. In the event of the trailing cable in service breaking down, or becoming damaged in any way, or of its inflicting a shock upon any person, it shall at once be put out of service. The faulty cable shall not again be used until it has been repaired and tested by a properly authorized person.

18. In any gaseous portion of a mine, a coal-cutting machine shall not be brought within the last breakthrough next the working face until the machine man shall have made an inspection with the use of an approved safety lamp for gas in the place where the machine is to work, unless such examination is then made by some other competent person authorized or appointed for that purpose by the mine foreman. If any explosive gas is found in the place the machine shall not be taken in.

19. No coal-cutting machine shall be continued in operation in a gaseous portion of a mine for a longer period than half an hour without an examination as above described being made for gas, and if gas is found the current shall at once be switched off the machine and the trailing cable shall forthwith be disconnected from the power supply.

20. The person finding gas shall at once report the fact to the fireboss or mine foreman, and the machine shall not again be started in such place until the fireboss or a person duly authorized by the mine foreman has examined it and pronounced it safe.

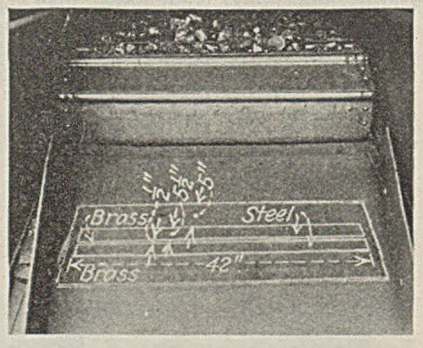
21. The person in charge of a coal-cutting machine shall not leave the machine while it is working, and shall, before leaving the working place, see that the current is cut off from the trailing cable.

22. In any gaseous portion of a mine, if any electric sparking or arc be produced outside of a coal-cutting motor or by the cables or rails, the machine shall be stopped, and not worked again until the defect is repaired, and the occurrence shall be reported to an official of the mine.

(Acknowledgment hereby made to the Union Pacific Coal Co. and to G. N. Newman, Pennsylvania bituminous electrical inspector.)

Tramp-Iron Magnet Is Set In Bottom of Chute

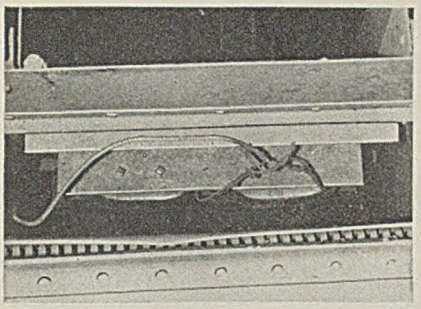
When officials of the Island Creek Coal Co., Holden, W. Va., decided to equip preparation plants of the company with magnets to remove tramp iron from the coal, they found it would be necessary to install at least eleven magnets; therefore they sought to design a type of magnet



Magnet Installed in Short Chute at End of Loading Boom. Pole Pieces and Brass Plates Outlined With Chalk.

which could be built in the company shop for a nominal sum and which would be easy to install.

A magnet with pole pieces forming a portion of the bottom plate of a chute was designed and built. A trial installation of a few weeks under actual operating conditions proved this to be quite satisfactory, consequently ten more of the same general design were built and installed. Some are in slack chutes, others in shakers, and still

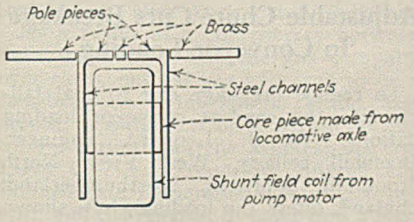


Coils on Bottom Side of Loading-Boom Chute.

others in short chutes or aprons added to the discharge ends of loading booms.

Referring to the photographs and to the sketch, the pole pieces consist of the flanges of two channels of which the opposite flanges have been cut off. The gap of ½ in. is filled with brass or bronze, and plates of the same material surround the pole pieces and thus discourage magnetic leakage, which would weaken the magnetism across the gap.

Four shunt field coils of round design and identical with the fields used in a 10-hp. 550-volt direct-current pump motor are mounted on core pieces bolted between the channel webs. The core pieces were made at minimum expense simply by cutting appropriate lengths from scrap locomotive axles. Some of the Island Creek



Section Showing Construction of Magnet.

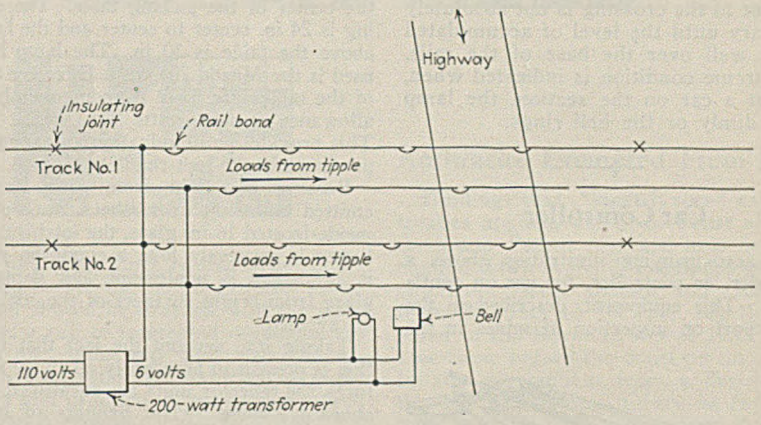
mines operate on 550 volts direct current and others on 275 volts. At the 550-volt plants the four field coils are connected in series, and at the 275-volt plants they are connected two in series per group, two groups in parallel.

The photographic view looking up at the under side of a chute and showing the magnet coils is of one of the first magnets installed. In this design two mining-machine-motor coils of rectangular shape were used. Most of the magnets are of the improved design, using the four round coils.

Magnetic pull is such that it is difficult to remove by hand a piece of iron from the chute if the power is left on. Coal sliding by does not dislodge tramp iron that has been trapped by the magnet.

Applying Car Stops

George Jackson, Kenilworth, Utah, after reading Lloyd G. Fitzgerald's Operating Idea on the use of discarded drawbar ends for car stops (March *Coal Age*, p. 111). offers a pertinent comment on the use of various types of stops underground. In dip workings in particular, where stops are used on jumpers, these short pieces of rail should be drilled at both ends to allow them to be fishplated solidly to the main track, says Mr. Jackson. Where this is done, a car cannot push the short rail forward past the spikes and thus tip over into the face, endangering the miner.



Simplicity and Low Cost Feature This Crossing Signal.

Tipple Crossing Signal Built Without Relays

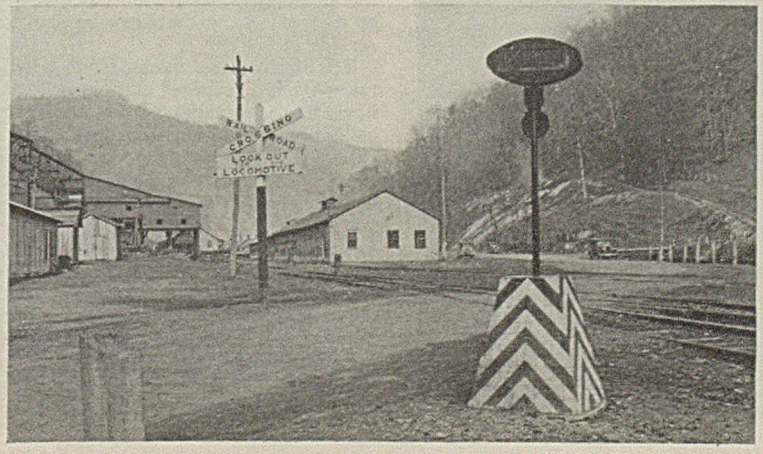
Loaded railroad cars being dropped down from the tipple to the storage yard are a menace to foot or vehicle traffic if there be a crossing of either type between the tipple and yard. The car glides along, making but little sound, and, although it is moving at a relatively low speed, the car dropper, even if he does notice a person or vehicle in danger, may have considerable difficulty in stopping it in time to prevent an accident. An automatic alarm is the accepted best arrangement for such a situation. Several practical methods of operating such an alarm are in use. One of the simplest type and costing the least is in use at the Junior mine of the Norfolk & Western Ry. fuel department, Chattaroy, W. Va.

At this mine, a highway crosses three tracks at a point a few hundred feet below the tipple. A section of track beginning about 200 ft. above and extending to a joint just below the crossing has one rail insulated. The same is true of each of the other two tracks, and all other rail joints of the three tracks are bonded. Current at 6 volts potential to illuminate a red glass marked "Stop" and to ring a bell, both located at the crossing, is supplied direct from a small transformer energized from the town lighting circuit.

The 6-volt circuit is automatically closed through the establishment of an electrical connection from one rail through the trucks to the other rail as the car comes onto the insulated section of track, and is automatically opened when the car leaves the section. Although the danger signals include both the bell and the illuminated red-colored stop sign, it is planned to add a waving arm or target, this to be actuated by the same 6-volt power driving a back-geared motor such as is employed in electrically operated automobile windshield wipers.

The transformer is rated 200 watts, and the dimensions are approximately double those of the ordinary toy-train transformer. With this type of installation the question of the formation of a conducting path between the rails through wet ties or accumulated dirt arises. Experience has shown that with a relatively short section of track this is of little consequence. Track cleaning

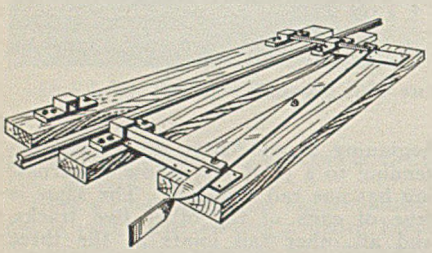
Stop Light and Bell Warn Traffic of Cars Coming From the Tipple.



adjacent to the crossing is not absolutely necessary until the level of accumulated dirt is well over the base of the rails. An extreme condition is indicated when, without a car on the section, the lamp lights dimly or the bell rings.

Car Controller

The accompanying illustration shows a car feeder, or controller, for use on gentle grades. This equipment, described in the 1932 report on inspection of mines in the



Foot-Operated Car Feeder.

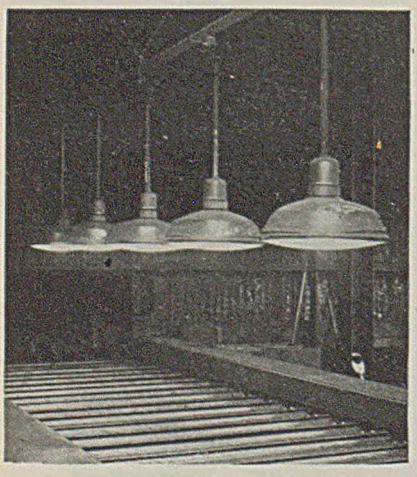
Yorkshire division, England, is foot-operated, and by adjusting the length can be made to feed one, two or three cars at a time.

Island Creek Equips Tables With Day-Blue Lights

It is characteristic of the management policy of the Island Creek Coal Co., operating in Logan County, West Virginia, that wholesale changes in equipment are made when tests indicate with certainty that the improved equipment will be a sound investment. Last year the picking-table lighting was scrutinized, and as a result all tables at the five mines now operating were equipped with lighting units of a type generally accepted as representing the best practice for coal picking.

Reflector units are the Westinghouse 16-in. Type RLM heavy-duty equipped with dust-tight cover of frosted day-blue glass. These are mounted five in a row above the center of the picking table. The spacing is 24 in. center to center and the height above the table is 30 in. The lamp being used is the Mazda 200-watt. Effective areas of the tables are 5x12 ft., consequently the allowance is 16⅔ watts per square foot. This provides an illumination averaging approximately 30 foot-candles.

Picking-Table Lighting at Mine No. 21.



Because the light from each lamp is emitted uniformly from the surface of the inside-frosted 16-in. glass, the intrinsic brilliancy is relatively low, a condition which is necessary if unpleasant and damaging glare from bright surfaces of the coal is to be avoided.

Taking into account the fact that vibration is present in practically all tipple structures, the reflector units are suspended from shock-absorbing swivel hangers of standard commercial design. These successfully protect the lamp filaments from undue strain, but a minor difficulty was encountered. After a few months of use the solid conductor wires used in the installation began to break. This was corrected by rewiring the units and feeder conduit with stranded conductor.

As yet there appears to be no practical way of preventing the accumulation of dust on the glass cover of reflector units. A cloth is kept available for use once a day or several times a day to wipe off the dust and maintain approximately full intensity of illumination.

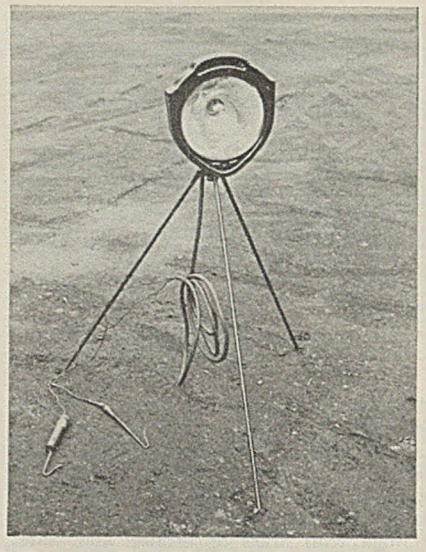
The design of this picking-table lighting is that recommended by illumination engineers of the manufacturer of the reflector units. It was adopted by that manufacturer after a series of tests with several types of illuminants arranged to determine the proper intensity and direction.

Light Weight Achieved in Track Aligning Light

Working without adequate light is a common practice even on routine production jobs, and on repair and maintenance jobs lack of adequate or properly arranged lighting is general. Officials at Chattaroy mine of the Norfolk & Western fuel department, Chattaroy, W. Va., realized the need of better lighting for the mine-track crews and acted instead of just continuing to "realize." Now each crew is supplied with a light-weight tripod-mounted flood lighting unit, and an extra unit is kept at the main shop ready for emergency jobs or to replace any that may be damaged in service.

The lights are made from headlamps taken from dismantled automobiles.. These have the advantages of light weight, excellent reflectors, and practically dust-tight cases. A standard screw-base socket is fitted into the case and the reflector is cut to accommodate a 250-volt lamp of medium wattage. The socket is positioned to give the desired distribution of light.

Tripod legs are made from ⅜-in. soft round steel. Two are 3 ft. long and the other, extending to the front, is 4 ft. long. Having the front leg longer makes for better balance of the unit in case it becomes necessary to throw the light upward. Ordinarily, of course, in aligning track the



Complete Light Unit for Aligning Track.

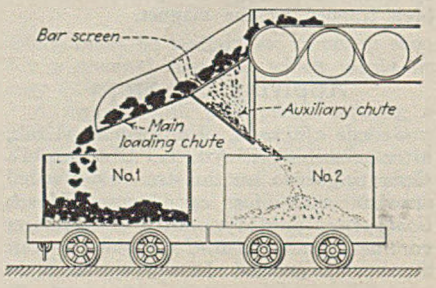
lamp is set so that the beam is inclined slightly below the horizontal.

Terminals of the portable rubber cord attached to the light are fitted with nips. That for connection to the rail circuit is insulated with tape, and is attached first. The nip attached to the trolley is fitted with a wood or fiber handle.

Adjustable Chute Cuts Breakage In Conveyor Loading

To reduce breakage due to coal falling into the cars at conveyor loading stations, W. J. Leonard, engineer, Broomhill colliery, West View, North Broomhill, Morpeth, Northumberland, England, offers the loading chute shown in the accompanying illustration. A feature of the chute is the use of a bar screen with supplementary chute, which screens the fines out of the material discharged by the conveyor and directs them to the rear, or No. 2, car. The large coal falls into No. 1 car. When loading of the No. 1 car is finished, No. 2, which is partly filled with fines, is moved under the main loading chute, and the large coal falls onto the bed of fines instead of the hard car bottom, thus reducing breakage. The main chute is adjustable to compensate for the rate of discharge; otherwise the equipment is automatic in action and contains no moving parts.

Construction of Conveyor-Loading Chute.



WORD from the FIELD

Seek Natural-Gas Agreement

In accordance with a proposal by the NRA, which followed the submission of a brief in behalf of legislation for a natural-gas tax to the Division of Economic Research and Planning by representatives of the National Coal Association and the United Mine Workers on March 13, several conferences have been held between representatives of the coal and natural-gas industries in an attempt to work out a formula by which coal would be used as the price yardstick and natural gas, by a code provision, would agree that that product should not be sold for less than the relative delivered cost of coal per B.t.u., including handling costs. District meetings were adopted as the best method of getting down to business and two were held in April—at Chicago and Kansas City. These resulted in the adoption of the principle that committees of engineers representing both industries should take over immediately the question of equitable arrangements, and such a committee was appointed at the Kansas City meeting. If the two meetings yield satisfactory results, it is planned, according to reports, to hold others at Denver, Des Moines, New York and Birmingham.

As a result of a controversy between the City Council and the gas company over rates, natural gas appeared to be a possibility in Minneapolis, Minn., last month. Contingent on a permit to distribute natural gas, the Minneapolis Gas Light Co., it is reported, offered the Council rate reductions averaging 6 per cent, and is prepared to enter into a contract with the Northern Natural Gas Co. for sufficient gas to provide a mixture of 60 per cent natural and 40 per cent oil gas.

Additional losses to natural gas reported in the past few weeks include the following: Penick & Ford, Cedar Rapids, Iowa, formerly using 100,000 tons of screenings per year, and the Libby-Owens-Ford Co., Ottawa, Ill., partial conversion replacing 75,000 tons of screenings per year. Erie Forge & Steel Co., Erie, Pa., it was reported, will change to fuel oil in protest against higher screenings prices. Annual consumption has been 15,000 tons. A proposal to convert the Knoxville (Iowa) Veterans' Facility to natural gas in a modernization project to be carried out with PWA funds met with strong protests from the Iowa Coal Trade Association, Iowa subdivisional code authority, the National Coal Association and the United Mine Workers last month, with the result that prospects appeared bright for a continuation of coal use.

Developments in the past few weeks in the long-standing discussion of the utilization of Michigan natural-gas reserves included an order for an investigation into resources in the State in an attempt to determine whether applications for laying lines to the larger cities pending before the Public Utilities Commission should be granted, and the issuance of a call to interested municipal officials and industrial consumers to attend a conference on natural-gas regulations and production, transmission and distribution rules.

May Lengthen Scrip Study

Reports current last month indicate that the study of the scrip payments provided for in the retail trade, retail jewelry and retail food and grocery codes may be extended beyond July 1, originally set as the date for the submission of a report by an investigating committee composed of Dr. Charles Fowler, professor of economics, College of the City of New York; Daniel Bloomfield, executive secretary, Boston Retail Trade Board; and Dr. Henry Post Dutton, professor of factory management, Northwestern University, and associate editor, *Factory Management and Maintenance*. The committee held a joint conference with a National Coal Association committee composed of Hugh Morrow, president, Sloss-Sheffield Steel & Iron Co., Birmingham, Ala.; P. C. Thomas, vice-president, Koppers Coal Co., Pittsburgh; and C. B. Huntress, executive secretary of the association, early in April, and later indicated that members would personally investigate the company-store situation in Pennsylvania, West Virginia, Tennessee and Alabama, in addition to employing one or two investigators to look into conditions in other fields and other industries.

Harris & Ewing

Carroll B. Huntress

Anthracite Exempted From Duty

Holding that "most-favored-nations" treaties applied, the U. S. Court of Customs and Patent Appeals, in a decision handed down April 2, exempted anthracite from Great Britain and Germany from the duty of 10c. per 100 lb. provided in the Revenue Act of 1932. The case came before the court on an appeal by the government from a decision in the U. S. Customs Court in favor of the Domestic Fuel and George E. Warren corporations, which contended that inasmuch as coal from Mexico and Canada were admitted free in accordance with the provision of the 1932 Act allowing exemption where the balance of trade was favorable to the United States, coal from Great Britain and Germany also should be admitted free under "most-favored-nation" treaties.

Huntress to New Post

Carroll B. Huntress, for four years executive secretary, National Coal Association, Washington, D. C., was elected president of Appalachian Coals, Inc., last month, and will assume his new duties May 1. Mr. Huntress succeeds James D. Francis, vice-president, Island Creek Coal Co., Huntington, W. Va., who resigned to further his contention that the company should have a full-time paid executive head. A native of New Hampshire and a Harvard graduate, Mr. Huntress was engaged in newspaper work for ten years after leaving school and then went into organization work in Indiana, Ohio, Pennsylvania and, from 1919 on, in Washington. He joined the National Coal Association staff in 1924, and seven years ago was made assistant to the executive secretary, taking over the secretaryship three years later.

New Plant for Kehoe-Berge

Kehoe-Berge Coal Co., Pittston, Pa., has contracted with the Chance Coal Cleaner and the Staples-Sweeney Mfg. Co. for the erection of a new breaker at its William A. colliery, Wilkes-Barre, Pa. The breaker will receive coal from both mine and railroad cars, and will be equipped with a 15-ft. Chance cone for egg to pea, inclusive, and a 10-ft. rectangular-top cone for pea to No. 4 buckwheat, inclusive. Capacity of the new plant is 250 tons of cleaned coal per hour. General features include: steel structure, corrugated-metal roofing and siding, steel-sash windows; four sets of rolls; shaker screens; V-belt drives; and installed motor horsepower totaling 600. The plant will be completed and go into operation July 1.

NRA Reaffirms Approval of 35-Hour Week; Modifies Stand on Differentials

THE SEVEN-HOUR DAY and five-day week, first imposed upon the entire bituminous coal-mining industry by an "emergency" order issued by NRA on March 31, to become effective the following day, was reaffirmed in a new order promulgated by General Johnson, National Recovery Administrator, April 22. Under the new order, however, differentials in base rates accorded mines in Alabama, southern Tennessee and Georgia are restored, subject to the proviso that operators in that area shall not be permitted to undersell competitive fields paying higher wages. An increase of 85c. in basic inside rates in the Southwest is cut to 60c. and advances in tonnage rates in northern West Virginia are modified pending further study. The new order also creates a Bituminous Research Unit in the NRA Division of Research and Planning.

Issuance of the order of April 22 followed a spirited three-day hearing on the original order, held at Washington April 9-11. This hearing had been preceded by an appeal to the courts by Alabama commercial operators which resulted in the issuance of a temporary restraining order by the federal district court at Birmingham, and by suspensions in several fields. In Alabama, where the operators had closed down until the temporary restraining order had been issued by the district court, the situation threatened to become dangerous and national guardsmen were called out. Southern industrial interests who viewed the "emergency" order as a direct attack upon their survival in the national competitive picture met in Birmingham April 19 to consider united action. That such was the purpose of the national administration, however, was specifically denied by President Roosevelt in a statement made April 22 in which he appealed to all workers to accept the new schedules and return to their jobs.

The order of March 31, officially Amendment No. 1 to the Code of Fair Competition for the Bituminous Coal Industry, amended Articles III and IV of the code and Schedule A in accordance with proposals submitted on March 30 by the Eastern, Western Pennsylvania and Ohio Subdivisional Code Authorities of Division I. These amendments, with the additions made by the revised order of April 22 shown in italics and matter struck out in the April revision shown in brackets, read as follows:

ART. III—MAXIMUM HOURS OF LABOR

No employee, except members of the executive supervisory, *clerical*, technical and confidential personnel, shall be employed in excess of seven hours per day and five days per week, subject to the exceptions hereinafter stated.

Seven hours of labor shall constitute a day's work and this means seven hours' work at the usual working places for all classes of labor, exclusive of the lunch period, whether they be paid on the day or the tonnage or other piecework basis, except in cases of accident which temporarily necessitate longer hours for those required on account thereof; and also excepting that number of workers in each mine whose daily work includes the handling of man-trips and those required to remain on duty while men are entering and leaving the mine.

The following classes of mine workers are exempted from the provisions as to the maximum hours of work:

(a) All workers engaged in the transportation of coal shall work the additional time necessary to handle man-trips, and/or haulage animals, and all coal in transit, and shall be paid the regular hourly rates. Mine workers engaged in the dumping, handling and preparation of coal, and in the manufacture of coke, shall work the additional time necessary, not to exceed 30 minutes, to dump and prepare the coal delivered to the tipple each day and to complete the usual duties incidental to the operation of coke ovens, and shall be paid the regular hourly rates. This rule shall not encourage the working of such overtime except where it is necessary to take care of the conditions named.

(b) Employees engaged at power houses, substations and pumps operating continuously for 24 hours daily are especially exempted from the seven-hour provision. Special exemption of employees other than those named above may be provided, by joint agreements negotiated in accordance with this code, which shall not provide for work in excess of 8 hours per day and 40 hours per week.

ART. IV—MINIMUM RATES OF PAY

From April 1, 1934, to April 1, 1935, the basic minimum rate for inside skilled labor and the basic minimum rate for outside common labor shall be the rate hereinafter set forth in *New* Schedule A for each district therein described for each such classification of labor, with the understanding that other classifications of employment shall maintain their customary differentials above or below said basic minimum rates.

To secure the parity between minimum rates for day labor and minimum pay for work performed on a tonnage or other piecework basis, the latter shall be determined by the following increases over existing rates in all of the districts of *New* Schedule A except as hereinafter expressly provided:

On the basis of the 2,000-lb. ton, an increase of 10c. per ton for pick mining; 8c. per ton for machine mining; an increase of 1c. per ton for cutting, and for all yardage and deadwork rates an increase of 9 per cent.

In addition to the increases above provided the minimum rates for tonnage and other piecework in Districts B, G, H, J and J-1 shall be further increased, *if necessary*, by an amount sufficient to maintain [the parity] *the customary relationship in the industry* between pay for such tonnage and piecework and the basic minimum rates for day labor as prescribed for such districts in *New* Schedule A.

That said requirement, as to increases in District B, shall be satisfied pending further order, by an increase per 2,000-lb. ton for said district of 2½c. in loading rates and ½c. in cutting rates.

The order of April 22 also sets up the following provisions not part of the "emergency" order of March 31:

In view of the differentials hereby accorded District J, pending further order there shall be no sales by operators in said district into the normal consuming markets of another district which is subject to higher rates of pay, at any prices for coal of comparable grade and quality, less than the price for such coal in said market charged by such other district, and there shall be no destructive invasion of such other consuming markets and, in the absence of satisfactory agreements governing this matter, the determination of the Administrator, on complaint, of such destructive invasion shall be conclusive.

Full study shall be made by the NRA as to adjustments in the price structure within the bituminous coal industry, equitably required in consideration of the rates of pay in effect in the several districts of said industry, and to that end there shall be created a Bituminous Coal Research

Table I—Comparative Basic Minimum Hourly Code Rates for Inside Skilled Labor and Common Outside Labor

	New Schedule A		Emergency Order of March 31		Original Code	
District A	Inside	Outside	Inside	Outside	Inside	Outside
Pennsylvania, Ohio, Lower Peninsula of Michigan, Panhandle District of W. Va.[1]	71 5/10	57 1/10	71 5/10	57 1/10	57½	45
District B						
Northern West Virginia [2]	71 5/10	57 1/10	71 5/10	57 1/10	54½	42
District C						
Southern West Virginia[3], Eastern Kentucky[4], Upper Potomac District of W. Va.[5], Maryland, Virginia, Northern Tennessee[6]	65 7/10	51 5/10	65 7/10	51 5/10	52½	40
District D						
Indiana	65½	60	65½	60	57½	52½
District E						
Illinois	71 5/10	57 1/10	71 5/10	57 1/10	62½	50
District F						
Iowa[7]	67 1/10	57 1/10	67 1/10	57 1/10	58¾	50
Wayne and Appanoose Counties, Iowa	65 1/10	57 1/10	65 1/10	57 1/10	57	48¼
District G						
Missouri, Kansas, Arkansas, Oklahoma	62 1/10	53 9/10	65 7/10	57 1/10	46⅞	41
District H						
Western Kentucky[8]	65 7/10	53 9/10	65 7/10	53 9/10	50	37½
District J						
Alabama, Georgia, Southern Tennessee, Hamilton and Rhea Counties	54 3/10	40	65 7/10	51 5/10	42½	30
District J-1						
Marion, Grundy, Sequatchie, White, Van Buren, Warren and Bledsoe Counties, Tennessee	60 5/10	46 3/10	65 7/10	51 5/10	48	35½
District K						
New Mexico	72 9/10	58 9/10	72 9/10	58 9/10	56	46⅞
Southern Colorado[9]	72 9/10	58 9/10	72 9/10	58 9/10	55½	46⅞
District L						
Northern Colorado[10]	75	60 7/10	75	60 7/10	62½	46⅞
District M						
Utah	77 1/10	64	77 1/10	64	68	56
District N						
Southern Wyoming	77½	63½	77½	63½	67¾	55½
Northern Wyoming	77½	64 9/10	77½	64 9/10	67¾	56¾
District O						
Montana	80½	68 9/10	80½	68 9/10	70⅜	60¼
District P						
Washington	77 1/10	57 1/10	77 1/10	57 1/10	67½	50
District Q						
North Dakota, South Dakota	64 3/10	52 9/10	64 3/10	52 9/10	50	40

[1]Includes Hancock, Brooke, Ohio and Marshall counties.

[2]Includes Monongalia, Marion, Harrison, Taylor, Lewis, Barbour, Gilmer, Upshur, Randolph, Braxton, Preston and Webster counties, and those mines in Nicholas County served by the B. & O. R.R.

[3]Includes all mines in counties in West Virginia not named under Districts A and B and the Upper Potomac district.

[4]Includes all mines in Kentucky located east of a north and south line drawn along the western boundary of the City of Louisville.

[5]Includes Grant, Mineral and Tucker counties.

[6]Includes all counties in Tennessee not named under Southern Tennessee in District J and J-1.

[7]Excludes Wayne and Appanoose counties.

[8]Includes all mines in Kentucky west of a north and south line drawn along the western boundary of Louisville.

[9]Includes all counties in Colorado not named under District L.

[10]Includes Jackson, Larimer, Weld, Boulder, Adams, Arapahoe, El Paso, Douglas, Elbert and Jefferson counties.

Note: Differences between districts in the foregoing minimum rates are not to be considered as fixing permanent wage differentials or establishing precedents for future wage scales.

Unit within the Research and Planning Division of said administration to conduct such study, to advise the Administrator on approval of proposed prices, and to make recommendations concerning such readjustment of the price structure.

Said Amendment No. 1 as modified in accordance herewith, be and the same hereby is in all respects affirmed and approved, subject, however, to such further modification in any schedule therein as further investigation and fact-finding by the Division of Research and Planning may discover to be necessary. Said division will vigorously continue its present research into wages, prices and hours of labor in each of the affected divisions.

The hourly wages set forth in the New Schedule A, as compared with those in the original code and the rates named in the "emergency" order of March 31 are shown in Table I. In the case of Districts D, E, F, M, N, O and P, the advances in hourly rates are due solely to the payment of the same basic scale for seven hours work as applied for eight hours when the code went into effect last October. Districts K and L increased their rates above the code minima when they gave general recognition to the United Mine Workers last fall.

Protest against any immediate action on the amendments was voiced by every district represented at the March conferences (*Coal Age*, Vol. 39, p. 150) except the sponsoring subdivisions, Michigan and northern Colorado. Asserting that they had not heard the proposals until read that afternoon, protestants asked for time to study them before they committed their districts. John L. Lewis, president, United Mine Workers, indorsing the amendments, urged immediate action on the ground that code wage schedules otherwise would terminate on March 31.

Blackwell Smith, NRA legal staff, explained that the meeting was not a public hearing, although it "was the first real meeting of the conference" set by the code for Jan. 5. Nobody, he said, would waive any legal rights by silence, but, "for the purpose of putting out a proposal which will be more difficult to change after it is out than before, we are forced to p esume that anyone who remains silent gives his assent."

After two hours, the meeting adjourned until March 31, when a session of an hour and one-quarter left the situation unchanged. That evening, NRA, stating that "a serious emergency" threatened the industry, adopted the proposals presented and made them effective as code amendments pending public hearing on April 9.

During the first week of April, Illinois and Indiana operators accepted the 7-hour day, although their contracts with the union, entered into prior to the enactment of NIRA, carried an 8-hour clause. The Sahara and Wasson Coal companies, Saline County, however, held out for the 50c. differential in their agreements with the Progressive union, and a strike ensued at their operations. Iowa expressed a willingness to abide by the order but reported that most of the miners refused to work. Only a few western Kentucky mines operated. Southwestern strippers continued digging. Arrangements were made in Rocky Mountain States to line up with the new mandate. Except for a few mines, northern West Virginia was down. "Holiday" suspensions occurred in some districts signatories to the new Appalachian wage agreement; Logan County, West Virginia, was the hardest hit by such stoppages.

When "the public hearing" opened on April 9, attack on the order was led by Forney Johnston, counsel for Alabama protestants, who defied NRA officials to show any evidence justifying the increase in that field. His contention that the Alabama agreement of March 16 was signed only after formal assurances that the miners had no intention of initiating any wage increases was challenged by Mr. Lewis, who insisted that the contract provision making wages and hours subject to NRA was a complete answer to that argument. Mr. Johnston retorted that the operators understood that they might be called upon to pay a "proportionate" increase in any general advance, but did not expect differentials to be upset.

He contrasted the proposed rates of 54.4 and 65.7c. per hour with rates ranging from 27 to 40c. in codes approved for other Southern industries. To permit these coal rates to stand, said Mr. Johnston, would be to return the South to its pre-Civil War agricultural status, since acceptance would be a prelude to advances in rates for other Southern enterprises which would destroy the industry of that section. The $4.60 base would increase costs approximately 83c. per ton. In view of competitive conditions, it would be impossible to advance prices sufficiently and still hold any substantial percentage of the present diminished business.

Southern Tennessee and Georgia producers, said H. J. Weeks, already have their markets circumscribed by adverse freight rates; their largest remaining natural market—Chattanooga, Tenn.—is in the heart of the TVA development. John S. Fletcher, general counsel, and Edel Wood, general secretary, Chattanooga Manufacturers' Association, agreed that higher prices would turn buyers to other coals and other fuels.

That the Southern Appalachian Coal Operators' Association declined to sign the new wage agreement until definitely assured that Division III base rates would be advanced to $4.60 was frankly admitted by L. C. Gunter, executive vice-president. He denied that operating conditions farther South differed materially from those in eastern Kentucky and northern Tennessee and attacked Alabama price-zoning with a spread of $1.20 between the lowest and highest rated zones on the same coal. "All the gentle sophistry in the world," he remarked, "cannot wipe out the fact that under the operation of the code with the differentials as they existed we lost 51 per cent of our business" in the Chattanooga market. If NRA modified differentials in favor of Division III, southern Appalachian operators wanted the same modifications. This demand was echoed by E. C. Perkins on behalf of the Hazard (Kentucky) district.

J. Van Norman said the order of March 31 would result in slow strangulation of western Kentucky. Producers there, nevertheless, were willing to accept the 7-hour day at the $4 base rate. Mr. Norman denied that natural mining conditions in that field were comparable with Illinois or that the troubles of western Kentucky were due to poor preparation and inefficient management. Efficiency of western Kentucky management, he asserted, was demonstrated by the November NRA reports, which showed that the difference between labor and total costs was 12.96c. per ton less than in southern Illinois and 13.95c. less than in Indiana.

R. J. Billings, Southern Coal Co., Memphis, Tenn., testified that preparation by the larger western Kentucky mines was as good as that in any other field. Imposition of the $4.60 base would eliminate most of these mines and give a monopoly to Illinois and Indiana, said W. J. McLaughlin, Green River Valley Coal Co. There is practically no difference in natural conditions or in living costs between southern Illinois and western Kentucky, declared D. W. Buchanan, president, Old Ben Coal Corporation. Western Kentucky mines not adapted to large mobile loaders could mechanize with pit-car loaders. Harvey Cartwright, commissioner, Indiana Coal Operators' Association, also attacked the position taken by western Kentucky.

Speaking for the smokeless subdivisional code authority, W. A. Richards asked that the last paragraph of the proposed amendment to Art. IV be changed to provide that:

The minimum rates for tonnage and other piecework shall be reduced or increased in any of said districts, or subdistrict, which now has separate tonnage or other piecework rates, as may be necessary to secure parity between pay for such tonnage and piecework and the basic minimum rate for inside skilled day labor applicable to such district.

This modification would not only clarify the amendment, said Mr. Richards, but also would compel operators in districts not specifically mentioned to establish piecework rates on a basis of parity with inside skilled day labor rates and would prevent certain districts from continuing to underpay pieceworkers. During the 1933 wage negotiations, central Pennsylvania, he charged, had claimed that the Northern loader averaged ten tons per day, whereas November figures showed seven tons against eleven tons in the smokeless fields. If the central Pennsylvania miner is to earn as much compared to the basic day rate in the North as the smokeless miner does in comparison to the basic Southern rate, the central Pennsylvania loading rates "should be increased 17c."

Geographically, geologically and economically, declared F. A. Krafft, director of industrial relations, Consolidation Coal Co., at the opening of the April 10 sessions, northern West Virginia is entitled to retain its former differential status. Fairmont operators had no foreknowledge of the assault on this status until the question was brought to a vote in the joint wage conferences. These operators, he added, were even denied their request that the question be submitted to an impartial commission, although the conference did so refer Southern wage differentials.

"Annihilation of Fairmont," said J. Noble Snider, vice-president, Consolidation Coal Co., "is about the only thing" Ohio and Pennsylvania "have been able to readily agree upon and stick to since the code came into being." Pennsylvania has large areas of coal better than the best northern West Virginia can offer. This latter field is hemmed in by competing districts and must move through them to common markets at higher freight rates. Its one advantage of more economical operating conditions, concluded Mr. Snider, the amendments would take away.

Charles O'Neill, vice-president, Peale, Peacock & Kerr, readily admitted he wanted to see the northern West Virginia differential wiped out. Replying to Mr.

Richards, he said Northern operators and miners had agreed on the Pittsburgh thin-vein rate as the basing point for Ohio and Pennsylvania tonnage rates in the 1933 negotiations, but that Southern producers had declined to reveal their rates. In the 1934 negotiations, the Northern group had proposed a joint committee to study North-South differentials, but so far, he understood, smokeless operators had refused to agree. Disparity in tonnage earnings was due to spreading work and declining production in central Pennsylvania. A similar explanation for lower average piecework earnings in Ohio was given by R. L. Ireland, Jr., vice-president, Hanna Coal Co.

J. D. A. Morrow, president, Pittsburgh Coal Co., categorically denied any intention on the part of the joint wage conference to destroy the Fairmont field. Northern West Virginia, he asserted, had had three weeks' notice that differentials would be considered. As he saw it, only four arguments could be advanced for wage differentials: (1) difference in living costs, (2) precedent, (3) geological conditions, and (4) freight rates. There was, he continued, no difference in living costs between western Pennsylvania and northern West Virginia. Precedent should not be invoked in defense of inequities. He refused to concede that northern West Virginia had worse mining conditions than western Pennsylvania; but, where such conditions did exist, the workers should not be penalized. Neither should the miner suffer because of adverse freight rates, which, incidentally, hit Pittsburgh as hard as Fairmont.

Defending the 50c. Saline County differential, Patrick J. Hurley, counsel for the Sahara and Wasson companies, laid great stress on the decision of Division II labor board upholding contracts between his clients and the Progressive union and charged the United Mine Workers with fomenting strikes. Mr. Lewis, in a heated interchange of personalities, accused the coal companies of starving the men to force acceptance of the lower rate. W. C. Kane, attorney for the Wasson company, reiterated his plea of last summer for lower wages at hand-loading mines. William J. Sneed, president, District 12, United Mine Workers, opposed the differential; Claude E. Pearcy, president, Progressive Miners of America, said the question was one for NRA to decide.

Opening the evening session, George Heaps, Jr., stated that the Iowa Coal Operators' Association, while still opposed to shorter hours, was willing to comply with the emergency order pending this hearing. He insisted, however, that a basic curtailment in hours without a corresponding reduction in wage rates would hurt Iowa mining, already saddled with high costs and competition of substitute fuels. The emergency order, declared W. C. Shank, Division IV Code Authority, will make it impossible for Southwestern operators to carry out the purposes of NIRA.

This division, continued Charles S. Keith, general manager, Central Coal & Coke Co., meets the full brunt of competition from the nation's largest natural-gas fields, with pipe lines to 98 per cent of the communities of 2,000 or over in Nebraska, Kansas, Missouri, Oklahoma and Arkansas. In addition, since 1919, railroad fuel-oil consumption in the Southwest has increased 49 per cent and railroad coal consumption has declined 67.3 per cent. The plight of the Southwest was further emphasized by J. G. Puterbaugh, president, McAlester Fuel Co., who asked that members of the Arkansas-Oklahoma Coal Operators' Association be exempted from the order.

S. M. Thompson, Colorado-New Mexico Coal Operators' Association, protested against the differential in wages between Districts K and G. Colorado and northern New Mexico meet their main competition from the low-cost strip mines of the Southwest. District K, when it recognized the union last November, increased its base rate 26c. above the code minimum and should be given credit for this advance in any increase now ordered.

Hearty indorsement of the order was voiced by Miss Josephine Roche, Northern Colorado Coal Producers' Association, at the opening of the April 11 sessions. This association also advocated elimination of all differentials between base rates in Districts G, K and L. Stanley B. Houck, counsel for the Dakota Coal Code Authority, renewed his earlier objections against shortening hours in the lignite fields. The Dakotas faced the same competition from substitute fuels emphasized by other districts; they also were plagued with competition from small mines that ignored the code and from Canadian mines without any code. The increases proposed, he said, would place an intolerable burden upon consumers hard hit by a long agricultural depression.

Replying to Mr. O'Neill's statement that lower tonnage earnings in central Pennsylvania were due to declining production and spreading work, Mr. Richards retorted that Bureau of Mines figures on output per man per day proved the contrary to be true. He defended the refusal of the smokeless group to participate in further joint wage conferences by saying their experience last year "was lesson enough."

Will P. Dabney, a Harrisburg (Ill.) miner, opposed continuing the 50c. differential, which, he said, had been agreed to originally because of cut-throat competitive conditions existing prior to the adoption of the code. Interrogated by Frank H. Woods, president, Sahara Coal Co., Mr. Dabney declared that, if the machines were put back into the Sahara mines, the equipment "can stay in there until it rusts out. We are not going to work on them." Mr. Woods later stated that he was willing to try the 7-hour day, but wondered whether the industry could survive the costs entailed. "Railroads are going to substitute fuels if we try to raise the price." Domestic consumers already are "paying more than their fair share of the cost of sustaining the industry."

William Keck, secretary-treasurer, Progressive Miners of America, criticized the section allowing 30 minutes' overtime and denounced multiple shifting. Spencer H. Thompson and Charles Keeny protested that the Progressives had been ignored in negotiating new West Virginia wage contracts.

A parade of district presidents of the United Mine Workers rallied to the support of the amendments and disputed the claims of opposing witnesses. Dale Stapleton, president, District 28, also upheld the 30-minute overtime provision attacked by spokesmen for the Progressive union. Frank Wilson, president, District 13, favored raising base scales in Iowa to $5 outside of Wayne and Appanoose counties and to $4.86 in those two counties. Miners in southern Colorado and New Mexico, said Frank Hefferly, president, District 15, supported the amendments, but felt they should be given the same wage base as northern Colorado.

Philip Murray, international vice-president, United Mine Workers, estimated that the new Appalachian agreement would add 17 to 21c. per ton to costs, with the increase in northern West Virginia 20c. Eliminating the differential, he maintained, was necessary to prevent wrecking the price structure upon which wages depend by low prices in northern West Virginia. The Fairmont group, he observed, had had no hesitancy in voting to abolish differentials favoring other districts.

Mr. Johnston, renewing his attack on the "arbitrary" manner in which the order had been issued, announced that as far as Alabama was concerned, "the amendments are and will continue to be treated as null and void." Anxious as the State is to preserve the code, Alabama preferred "civil war" in the industry "to subjection of the industry to three proconsuls working through a military ringmaster."

Characterizing the Johnston presentation as "bombast," Mr. Lewis asserted that the Alabama operators came before NRA in a mood of studied defiance. He again stressed the provision in the Alabama contract making wages and hours subject to administrative order. The proposed amendments, "accepted by the overwhelming majority of the interests in the industry," he said, represent "the most constructive recommendations made for the rationalization of the industry in the life of anyone in the sound of my voice." The objections of the protesting groups had been answered by their competitors. Believing the proposals warranted by every logical, humane and economic reason, the union asked that NRA approve the amendments as submitted.

New Ohio Operation Planned

The Millwood Coal Co., operating as an affiliate of the Central West Coal Co., Columbus, Ohio, has been organized to develop a tract of 1,000 acres near St. Clairsville, Ohio, the product to be sold through the Central West organization. Operations, it is reported will start this summer. Officers are: president, D. L. Wallace, Nelsonville; vice-president, J. S. McVey, president, Central West Co.; secretary, Ralph G. Martin, Columbus.

Rise in Loadings Forecast

An increase of 13 per cent in coal and coke loadings in the second quarter of 1934 is forecast by Shippers' Regional Advisory Boards. The expected total of loadings is set at 1,385,545 cars, against actual loadings of 1,225,865 cars in the second quarter of 1933. Loadings of the 29 principal commodities, including coal and coke, are expected to increase from 3,945,568 cars last year to 4,367,725 cars this year, or 10.7 per cent.

Stoppages Mark Adoption of Shorter Day; Smokeless Agreement Signed

EARLY April presented a series of contrasts in bituminous labor developments, with the negotiation of agreements in a number of fields being paralleled by strikes, suspensions and lockouts in others as a result of the NRA "emergency" order of March 31 establishing the 7-hour day for the entire industry and removing the differentials previously enjoyed by a number of regions. The majority of these troubles, however, appeared to be on the road to solution on April 23, following the promulgation of the revised NRA order of April 22 (see p. 196), meeting in part the objections of several affected fields.

The NRA emergency order followed hard on the heels of the signing of the new Appalachian agreement on March 30, which cleared the way for the order by granting a 7-hour day and substantial wage increases to miners in all but the smokeless, southern Appalachian and northern West Virginia districts. Smokeless operators, however, entered into a separate agreement on April 2, and southern Appalachian operators accepted the Appalachian agreement on April 4 after a two-day suspension. Northern West Virginia operators had earlier withdrawn from the Appalachian negotiations in protest against a proposal to eliminate the differential under Pittsburgh and other Northern mines which they formerly had enjoyed, and the failure of the NRA to heed its contentions in preparing the March 31 order resulted in a general shutdown with the exception of the Kellys Creek Colliery Co. and the Dawson, South Pittsburgh, Lynch, Nora, Riley-McArdle and Silvester Bros. coal companies, which accepted the provisions of the order and entered into new contracts. With some relief in loading and cutting scales, though not in day rates, as a result of the April 22 order, northern West Virginia elected to go along, with the result that the majority of the mines in the field were reported to have reopened on April 23.

The text of the Appalachian agreement, which expires March 31, 1935, and provides for the establishment of a joint North-South differential commission (four miners and four operators from the South and a like number from the North) to investigate tonnage and day-wage differentials between Northern and Southern districts and report at a joint conference in Washington, D. C., Feb. 18, 1935, begins on the next page. The text of the smokeless agreement, including detailed wage scales for the five fields in the low-volatile group, begins on p. 202. This agreement marks the granting of the check-off by the smokeless operators.

Alabama commercial operators, who had entered into a one-year wage agreement on March 16 carrying a basic inside day scale of $3.40, refused to accept the terms of the March 31 order, which imposed a basic scale of $4.60 for seven hours, and on April 6 closed down 60 mines employing 15,000 men. On the same day, they secured a temporary injunction in the federal court restraining the NRA from enforcing the order, and under its protection attempted to reopen under the contract scale on April 9. This move was balked by the miners, who refused to return to work. By April 16, the dissatisfactoin of the miners had taken the form of attacks on such commercial mines as were still operating, as well as on captive operations, principally the Tennessee Coal, Iron & R.R. Co., which suspended operations at four mines on that date. A continuation of these clashes over the next few days resulted in the death of one man, injury of several others, mobilization of seven National Guard companies in Birmingham on April 18 and the dispatching of troops to several affected operations on the same day. With the April 22 order providing a basic inside day scale of $3.80, instead of $4.60, Alabama commercial operators entered into negotiations with the United Mine Workers April 23. Immediate consummation of a new contract was held up by a disagreement over the extent of the increase in tonnage and deadwork rates, however.

Southern Tennessee-Georgia operators also received the same concession as Alabama operators in the April 22 order, and as a result decided to reopen operations employing approximately 1,500 men, which were closed down on April 2.

The effective date of the Appalachian agreement found 7,000 miners in Logan County, West Virginia, out on a wildcat strike over a misunderstanding of the terms of the agreement. The stoppage ended on April 7. An unauthorized three-day strike of 400 men employed by the Consolidation Coal Co. in central Pennsylvania was met by a declaration by company officials that the penalty of $1 per man per day would be assessed on the strikers. Developments in western Pennsylvania were marked by the reopening of four operations of the Ellsworth Collieries Co. late in March and early in April under the captive-mine agreement. No trouble was encountered in the change to the 7-hour day.

Approximately 65 per cent of western Kentucky capacity was closed down on April 2 as a result of the March 31 order, operators objecting to the increase of 60c. in the basic day rate ($4 to $4.60). Relief was refused in the April 22 order, with the result that counsel for the West Kentucky Coal Operators' Association announced on April 23 that the matter would be taken to the federal courts.

Promulgation of the March 31 order was followed by a general suspension of one day in Illinois while arrangements were made for the changeover. Work was resumed on April 4 throughout the State on the new basis, the chief exceptions being the Sahara and Wasson companies, where a controversy over differentials under the general rates offered by the miners in return for the elimination of loading machines resulted in a shutdown. Illinois developments also were marked by another failure in the campaign of the Progressive Miners of America for federal assistance in its battle for control of the miners in the State. Progressive representatives on April 12 requested the National Recovery Review Board, organized to investigate the effect of code operation on small enterprises, to order a referendum of employees at Mines 43 and 47 of the Peabody Coal Co. The board refused to intervene on the ground that it lacked jurisdiction. Factional strife in the State resulted in the killing of a member of the United Mine Workers and the wounding of four other men in a series of gun battles at Kincaid, April 17, growing out of a village election, which was carried by the UMW ticket.

Iowa mines were largely closed in April as a result of a disagreement over the application of the March 31 order. The same condition prevailed at shaft mines in the Southwest, where operators protested against increasing basic rates from $3.75 to $4.60. Strippers, however, continued to run, it was reported, without a definite decision on wages. Partial relief was afforded in the April 22 order through a reduction of the day scale to $4.35, but reports on April 23 indicated that Southwestern operators would stick by their refusal to accept an increase. Southwestern developments also were featured by complaints against the Blue Ribbon Mining Co. and the Paris Purity Coal Co. alleging violation of the provisions of the bituminous code governing maximum hours of labor and exceptions. These complaints were made to the Division IV Bituminous Coal Labor Board by the Arkansas-Oklahoma subdivisional code authority, and the board, after investigation, recommended in each case that the violations be stopped, accompanying its recommendations with a warning that continuation would mean a joint request for prosecution by the board and the code authority.

Few difficulties were encountered in the change from the 8- to the 7-hour day in the Rocky Mountain region, a majority of the operators accepting the shorter day without objection. Several Washington mines, however, were closed on April 3, due to the activities of the Western Miners of America, which resorted to a strike in an attempt to gain control over operations in the State.

In the anthracite region, hearings on charges of discrimination, rate-cutting and other malpractices in District 1 brought by the United Anthracite Miners of Pennsylvania began at Wilkes-Barre, Pa., April 4, before James A. Gorman, umpire, and the Anthracite Board of Conciliation, acting as agents for the National Labor Board. Approxi-

Permissible Plates Issued

Two approvals of permissible equipment were issued by the U. S. Bureau of Mines in March, as follows:

Jeffrey Mfg. Co.; Type 61W conveyor; 10-hp. motor, 550 volts, d.c.; Approval 265A; March 19.

Justrite Mfg. Co.; Justrite dry-cell signal lamp; Approval 1013; March 21.

mately 200 cases involving conditions at the collieries of the East Boston, John Conlon, Miners Mills, Pittston, Kehoe-Berge, Susquehanna, George F. Lee, Dial Rock, Hudson, and Lehigh Valley coal companies had been heard when the hearings recessed on April 20 for two weeks or more.

The Maple Hill, Ellangowan, Knickerbocker and West Shenandoah collieries of the Philadelphia & Reading Coal & Iron Co., in the southern anthracite field, were closed down by a strike over mechanical-mining rates on April 16. The miners insisted on the regular contract rate instead of the day scale of $6.95 established by the company, and on April 20 turned down a compromise proposal, threatening a general strike at all operations of the company.

Following the adoption of a plan to eliminate overtime in District 7 on April 10, a United Mine Workers local closed down the Hazleton Shaft colliery of the Lehigh Valley Coal Co. on April 17 as a result of the company's refusal to discharge a man remaining on duty over the 8 hours set by the union. The strikers were ordered back to work on April 19 by the Anthracite Conciliation Board, but in the meantime the offending member was suspended for 99 years.

Appalachian Agreement

This agreement is made and entered into pursuant to the provisions of Sec. 7 (b) of the National Industrial Recovery Act.

This agreement, made the 29th day of March, 1934, between the Eastern Bituminous Coal Association, Georges Creek and Upper Potomac Coal Association, Somerset County Coal Operators' Association, Western Pennsylvania Coal Control Association, Ohio Coal Control Association, Northern Panhandle of West Virginia Coal Operators' Association, Operators' Association of the Williamson Field, Big Sandy-Elkhorn Coal Operators' Association, Hazard Coal Operators' Exchange, Kanawha Coal Operators' Association, Logan Coal Operators' Association, voluntary associations on behalf of each member thereof, and Harlan County coal operators signatory hereto, and Virginia coal operators signatory hereto, hereinafter referred to as the operators, party of the first part, and the International Union United Mine Workers of America and Districts 2, 3, 4, 5, 6, 16, 17, 19, 28, 30 and 31, hereinafter referred to as the mine workers, and on behalf of each member thereof, party of the second part. (New districts of the United Mine Workers of America may be established in this territory.)

Witnesseth: It is agreed that this contract is for the exclusive joint use and benefit of the contracting parties, as heretofore defined and set forth in this agreement; and it shall be construed as binding upon and effective in determining only the relations with each other of those represented by the parties signatory hereto. It is the intent and purpose of the parties hereto that this agreement will promote an improved industrial and economic relationship in the bituminous coal industry, and to set forth herein the basic agreements covering rates of pay, hours of work, and conditions of employment to be observed between the parties in the following districts constituting the Appalachian territory:

Northern Territory — Pennsylvania; Ohio, together with Ohio, Brook, Hancock, and Marshall Counties of West Virginia; and northern West Virginia, including Counties of Monongalia, Marion, Harrison, Preston, Taylor, Barbour, Randolph, Upshur, Lewis, Gilmer, Braxton, Webster, and that portion of Nicholas County containing coal or coal mines along the line of the B. & O. R.R.

Maryland and the Upper Potomac District, including Grant, Mineral and Tucker counties of West Virginia are in Northern territory, but Schedule C of the code of fair competition applies to these districts.

Southern Territory—The State of Virginia; Northern Tennessee; that part of Kentucky lying east of a line drawn north and south through the city of Louisville; and that part of West Virginia not included in Northern territory.

Maximum Hours and Working Time

Seven hours of labor shall constitute a day's work. The seven-hour day means seven hours' work in the mines at the usual working places for all classes of labor, exclusive of the lunch period, whether they be paid by the day or be paid on the tonnage basis; except in cases of accident which temporarily necessitate longer hours for those mine workers required on account thereof; and also excepting that number of mine workers in each mine whose daily work includes the handling of man-trips and those who are required to remain on duty while men are entering and leaving the mine.

The seven-hour day, five-day week (35 hours per week), as provided in this agreement, shall prevail.

The following classes of mine workers are excepted from the foregoing provisions as to the maximum hours of work:

All mine workers engaged in the transportation of men and coal shall work the additional time necessary to handle man-trips and all the coal in transit, and shall be paid the regular hourly rate. Outside employees engaged in the dumping, handling and preparation of coal, and the manufacture of coke, shall work the additional time necessary, not to exceed 30 minutes, to dump and prepare the coal delivered to the tipple each day, and complete the usual duties incidental to the operation of coke ovens, and shall be paid the regular hourly rates. This rule shall not encourage the working of overtime except where it is absolutely necessary to take care of the conditions named.

When day men go into the mine in the morning they shall be entitled to two hours' pay whether or not the mine works the full two hours, but after the first two hours the men shall be paid for every hour thereafter by the hour, for each hour's work or fractional part thereof. If for any reason the regular routine work cannot be furnished inside day men, the employer may furnish other than the regular work.

Drivers shall take their mules to and from stables, and the time required in so doing shall not include any part of the day's labor, their work beginning when they reach the change at which they receive empty cars, but in no case shall the driver's time be docked while he is waiting for such cars at the point named. The method at present existing covering the harnessing and unharnessing of mules shall be continued throughout the life of this agreement.

Motormen and trip riders shall be at the passway where they receive the cars at starting time. The time required to take motors to the passway at starting time and departing from the same at quitting time shall not be regarded as part of the day's labor, their time beginning when they reach the change or parting at which they receive cars, but in no case shall their time be docked while waiting for cars at the point named.

Employees engaged at power houses, substations and pumps operating continuously for 24 hours daily are especially exempted from the seven-hour day provision. Special exemptions for other individual employees than those named above, when 24 hours' continuous operation daily is required, are subject to arrangement between the mine management and district officers. Employees so especially exempted are limited to eight hours per day and 40 hours per week.

Holidays

Holidays to be recognized are referred to the various district conferences for settlement.

Basic Tonnage Rate

Pick mining is the removal by the miner of coal that has not been undercut, centercut or overcut by a machine. The basic rate for pick-mining and hand-loading of coal shall include the work required to drill, shoot and clean and load the coal properly, timber the working place, and all other work and customs incidental thereto.

A maximum shortwall machine differential of eleven cents (11c.) per net ton between pick- and machine-mining rates shall be maintained.

Any change in mining methods or installation of equipment that relieves the mine worker of any of the above duties and increases his productive capacity shall be recognized and a piecework rate agreed to therefor properly related to the basic rate.

The standard for basic tonnage rates shall be 2,000 lb. per ton; where the gross ton of 2,240 lb. is the measure, the equivalent rate shall be paid.

The basic tonnage, hourly and day wage rates for the various producing districts represented in this conference are shown in the attached Schedules, A and C, which are parts hereof.

Yardage and deadwork rates in all districts shall be increased nine (9) per cent.

Checkweighmen

The mine workers shall have the right to a checkweighman, of their own choosing, to inspect the weighing of coal; provided that where mines are not now equipped to weigh coal a reasonable time may be allowed to so equip such mines; and provided that in any case where on account of physical conditions and mutual agreement wages are based on measure or other method than on actual weights, the mine workers shall have the right to check the accuracy and fairness of such method, by a representative of their own choosing.

Cars shall be tared at reasonable intervals and without inconvenience to the operation of the mine. Tare shall be taken of the cars in their usual running condition.

At mines not employing a sufficient number of men to maintain a checkweighman the weight credited to the mine workers shall be checked against the billing weights furnished by railroads to the operators, and on coal trucked from such mines a practical method to check the weights shall be agreed upon. Such weights shall be checked once a month.

The wages of checkweighmen will be collected through the pay office semi-monthly, upon a statement of time made by the checkweighman, and approved by the mine committee. The amount so collected shall be deducted on a percentage basis, agreed upon by the checkweighman and clerk, from the earnings of the mine workers engaged in mining coal and shall be sufficient only to pay the wages and legitimate expenses incident to the office, except where the method of payment is otherwise provided by State law.

If a suitable person to act as checkweighman is not available among the mine workers at the mine, a man not employed at the mine may be selected upon mutual agreement.

The checkweighman, or checkmeasurer, as the case may require, shall be permitted at all times to be present at the weighing or measuring of coal, also have power to checkweigh or checkmeasure the same, and during the regular working hours to have the privilege to balance and examine the scales or measure the cars, providing that all such balancing and examination of scales shall only be done in such way and at such time as in no way to interfere with the regular working of the mine. It shall be the further duty of the checkweighman or checkmeasurer to credit each mine worker with all merchantable coal mined by him on a proper sheet or book kept by him for that purpose. Checkweighmen or checkmeasurers shall in no way interfere with the operation of the mine.

Boys

No person under seventeen (17) years of age shall be employed inside any mine nor in hazardous occupations outside any mine; provided, however, that where a State law provides a higher minimum age, the State law shall govern.

Exemptions Under This Contract

The term mine worker as used in this agreement shall not include mine foremen, assistant mine foremen, firebosses, or bosses in charge of any classes of labor inside or outside of the mine, or coal inspectors or weigh-bosses, watchmen, clerks, or members of the executive, supervisory, and technical forces of the operators.

Management of Mines

The management of the mine, the direction of the working force, and the right to hire and discharge are vested exclusively in the operator, and the United Mine Workers of America shall not abridge these rights. It is not the intention of this provision to encourage the discharge of mine workers, or the refusal of employment to applicants because of personal prejudice or activity in matters affecting the United Mine Workers of America.

Mine Committee

A committee of three (3) mine workers, who shall be able to speak and understand the English language, shall be elected at each mine by the mine workers employed at such mine. Each member of the mine

committee shall be an employee of the mine at which he is a committee member, and shall be eligible to serve as a committee member only so long as he continues to be an employee of said mine. The duties of the mine committee shall be confined to the adjustment of disputes arising out of this agreement that the mine management and mine worker, or mine workers, have failed to adjust. The mine committee shall have no other authority or exercise any other control, nor in any way interfere with the operation of the mine; for violation of this clause any or all members of the committee may be removed from the committee.

Settlement of Disputes

Should differences arise between the mine workers and the operator as to the meaning and application of the provisions of this agreement, or should differences arise about matters not specifically mentioned in this agreement, or should any local trouble of any kind arise at any mine, there shall be no suspension of work on account of such differences, but an earnest effort shall be made to settle such differences immediately:

First, between the aggrieved party and the mine management;

Second, through the management of the mine and the mine committee;

Third, by a board consisting of four members, two of whom shall be designated by the mine workers and two by the operators.

Should the board fail to agree, the matter shall be referred to an umpire selected by said board. Should the board be unable to agree on the selection of an umpire, he shall be designated by the Administrator of the National Industrial Recovery Act. The decision of the umpire in any event shall be final.

District conferences may establish an intermediate board consisting of two (2) commissioners, one representing the operators and one representing the mine workers, with such powers as said conference may delegate.

Pending the hearing of disputes, the mine workers shall not cease work because of any dispute; and a decision reached at any stage of the proceedings shall be binding on both parties thereto, and shall not be subject to reopening by any other party or branch of either association except by mutual agreement.

Expense and salary incident to the services of an umpire shall be paid jointly by the operators and mine workers in each district.

Discharge Cases

When a mine worker has been discharged from his employment and he believes he has been unjustly dealt with, it shall be a case arising under the method of settling disputes herein provided. In all discharge cases should it be decided under the rules of this agreement that an injustice has been dealt the mine worker, the operator shall reinstate and compensate him at the rate based on the earning of said mine worker prior to such discharge. Provided, however, that such case shall be taken up and disposed of within five days from the date of discharge.

Illegal Suspension of Work

A strike or stoppage of work on the part of the mine workers shall be a violation of this agreement. Under no circumstances shall the operator discuss the matter under dispute with the mine committee or any representative of the United Mine Workers of America during suspension of work in violation of this agreement.

Irregular Work

When any mine worker absents himself from his work for a period of two days without the consent of the operator, other than because of proven sickness, he may be discharged.

Preparation of Coal and Mining Practice

Each district agreement shall provide for the preparation and proper cleaning of coal. Proper disciplinary rules and penalties shall also be incorporated in such agreements.

Safety Practice

Reasonable rules and regulations of the operator for the protection of the persons of the mine workers and the preservation of property shall be complied with.

Engineers' and Pumpers' Duties

When required by the management, engineers, pumpers, firemen, power-plant and substation attendants shall under no conditions suspend work but shall at all times protect all the company's property under their care, and operate fans and pumps and lower and hoist men or supplies as may be required to protect the company's coal plant.

Shifts

The operator shall have the right during the entire period of this agreement to work all the mines, or any one or more of them, extra shifts with different crews.

When the mine works only one shift it shall be in the day time, but this shall not prevent cutting and loading coal at night in addition to the day shift cutting and loading.

Pay Day

Pay shall be made semi-monthly and at least twice each month.

Coke and Cleaning Plants

Proper rules may be negotiated in district conferences to provide for continuous operation of coking and cleaning plants.

Miscellaneous Provisions

Matters affecting cost of explosives, blacksmithing, electric cap lamps, and house coal are referred to the district conferences.

To the extent it has been the custom in each district, all bottom coal shall be taken up and loaded by the mine worker.

The cutter shall cut the coal as directed by the operator.

District Conferences

District agreements shall be made dealing with local or district conditions, and it is agreed that such district agreements shall embody the basic rates of pay, hours of work, and conditions of employment herein set forth, and all specific rights and obligations of operators and mine workers herein recognized.

This agreement shall supersede all existing and previous contracts; and all local rules, regulations and customs heretofore established in conflict with this agreement are hereby abolished. Prior practice and custom not in conflict with this agreement may be continued.

All internal differences are hereby referred to the various districts for settlement, with the understanding that only by mutual consent shall anything be done in district conferences that will increase the cost of production or decrease the earning capacity of the men.

Proper arrangements for collections for the United Mine Workers of America shall be made in district conferences.

Joint North-South Differential Commission

A joint commission of eight representatives of operators and eight representatives of mine workers is established to investigate the differentials on tonnage and day wage rates existing between the Northern and the Southern districts.

The Northern operators shall be represented by one member of the commission from each of the following organizations: Coal Control Association of Western Pennsylvania; Eastern Bituminous Coal Association; Ohio Coal Control Association.

Should Northern West Virginia Coal Association become signatory hereto a representative from it shall be named. If Northern West Virginia Coal Association does not become signatory, the fourth representative of the Northern operators shall be chosen by the three selected by the associations named above.

The Southern operators signatory hereto agree to designate four representatives to serve on the Joint North-South Differential Commission. Such members of the commission shall be fully representative of the Southern fields.

The United Mine Workers of America agree to designate eight members of the Joint North-South Differential Commission to be made up of four mine workers from the Northern fields and four mine workers from the Southern fields.

The commission shall report its recommendations to the joint conference hereinafter provided to meet Feb. 18, 1935.

The expense of this commission shall be borne jointly as follows: One-fourth by the Northern operators, one-fourth by the Southern operators, and one-half by the mine workers.

The Appalachian Wage Conference jointly recommends to N.R.A. that the Bituminous Coal Code Unit of the Planning and Research Division be continued for the purpose of assembling and compiling proper statistical data for the use of the Joint North-South Differential Commission.

Appalachian Joint Conference

A joint conference of representatives of the Eastern Bituminous Coal Association, Georges Creek and Upper Potomac Coal Association, Somerset County Coal Operators' Association, Western Pennsylvania Coal Control Association, Ohio Coal Control Association, Northern Panhandle of West Virginia Coal Operators' Association, Operators' Association of the Williamson Field, Big Sandy-Elkhorn Coal Operators' Association, Harlan County coal operators signatory hereto, Hazard Coal Operators' Exchange, Kanawha Coal Operators' Association, Logan Coal Operators' Association and Virginia coal operators signatory hereto, and the International Union United Mine Workers of America and Districts 2, 3, 4, 5, 6, 16, 17, 19, 28, 30 and 31, shall be held in the City of Washington, D. C., Feb. 18, 1935, to consider what revisions, if any, shall be made in this agreement as to hours, wages and conditions of employment, and to establish such differentials between districts as the conference finds in the report of the Joint North-South Differential Commission, hereinbefore provided for.

This agreement shall be submitted to the President for his approval under the terms of the bituminous coal code applicable to the territories embraced herein.

This agreement shall become effective April 1, 1934, and shall continue in effect until March 31, 1935.

In witness whereof each of the parties hereto, pursuant to proper authority, has caused this agreement to be signed by its proper officers.

United Mine Workers of America — John L. Lewis, president; Philip Murray, vice-president; Thomas Kennedy, secretary-treasurer; James Mark, president, district 2; Frank Hughes, president, district 3; William Hynes, president, district 4; P. T. Fagan, president, district 5; Percy Tetlow, president, district 6; James E. Jones, president, district 16; Van A. Bittner, president, district 17; William Turnblazer, president, district 19; Dale Stapleton, president, district 28; Sam Caddy, president, district 30; Frank Miley, president, district 31.

Charles O'Neill, Walter A. Jones, Eastern Bituminous Coal Association; Andrew B. Crichton, William W. Hill, Georges Creek and Upper Potomac Coal Association; Telford Lewis, Somerset County Coal Operators' Association; J. D. A. Morrow, B. H. Canon, Western Pennsylvania Coal Control Association; R. L. Ireland, Jr., D. F. Hurd, Ohio Coal Control Association; J. M. Vest, J. J. Ardigo, Operators' Association of the Williamson Field; E. R. Price, Thomas S. Haymond, Big Sandy-Elkhorn Coal Operators' Association; William W. Miller, Hazard Coal Operators' Exchange; D. C. Kennedy, Kanawha Coal Operators' Association; Herbert E. Jones, H. A. McAllister, Logan Coal Operators' Association; William Taylor, Northern Panhandle of West Virginia Coal Operators' Association; Harlan Coal Operators—N. B. Perkins (signatory for all Harlan companies parties to this agreement); Virginia Coal Operators—Stonega Coke & Coal Co., J. D. Rogers, vice-president; C. B. Neel, (signatory for all Virginia companies parties to this agreement).

Schedule A—Basic Rates Established in the Following Named Districts

Western Pennsylvania

	Tonnage Rates Per 2,000 lb. Run-of-Mine Coal
Pick mining, thin vein	$0.80
Pick mining, thick vein	0.75
Machine loading, thin vein	0.60
Machine loading, thick vein	0.56
Cutting, shortwall machine, thin vein	0.09
Cutting, shortwall machine, thick vein	0.08

Central Pennsylvania

Pick mining	0.80
Machine loading	0.60
Cutting, shortwall machine	0.09

Southern Somerset County, Pennsylvania

Pick mining	0.80
Machine loading	0.60
Cutting, shortwall machine	0.09

Connellsville, Pennsylvania

Pick mining	0.66
Machine loading	0.48
Cutting, shortwall machine	0.07

Westmoreland-Greensburg, Pennsylvania

	Tonnage Rates Per 2,000 lb. Run-of-Mine
Pick mining	0.75
Machine loading	0.56
Cutting, shortwall machine	0.08

Thick Vein Freeport, Pennsylvania

Pick mining	0.75
Machine loading	0.56
Cutting, shortwall machine	0.08

Ohio and the Panhandle District of Northern West Virginia

Pick mining	0.80
Machine loading	0.60
Cutting, shortwall machine	0.09

The following hourly and day wage rates shall be paid in all mines in Pennsylvania, Ohio, and the Panhandle district of Northern West Virginia for the classification of occupations shown herein:

Classification of Occupations	Hourly Rate	Day Rate
Inside:		
Motormen, rock driller	$0.737	$5.16
Drivers, brakemen, spraggers, snappers, coal drillers, trackmen, wiremen, bonders, timbermen, bottom cagers	0.714	5.00
Pumpers, trackmen helpers, wiremen helpers, timbermen helpers; and other inside labor not classified	0.680	4.76
Greasers, trappers, flaggers, switchthrowers	0.486	3.40
Outside:		
Bit sharpener, car dropper, trimmer, car repairmen, dumpers	0.606	4.24
Sand dryers, car cleaners, other able-bodied labor	0.571	4.00
Slate pickers	0.486	3.40

Skilled labor not classified to be paid in accordance with the custom at the mine.

SCHEDULE C—BASIC RATES ESTABLISHED IN THE FOLLOWING NAMED DISTRICTS

Maryland and Upper Potomac District, Including Grant, Mineral and Tucker Counties of West Virginia

All seams except Bakerstown and Waynesburg

	Tonnage Rates Per 2,000 lb. Run-of-Mine Coal
Pick mining	$0.722
Machine loading	0.530
Cutting, shortwall machine	0.090
Cutting, arcwall machine	0.058

Bakerstown Seam

Pick mining	0.780
Machine loading	0.650
Cutting, shortwall machine	0.090
Cutting, arcwall machine	0.058

Waynesburg Seam

Pick mining	0.780
Machine loading	0.600
Cutting, shortwall machine	0.090
Cutting, arcwall machine	0.058

Kanawha

Machine loading	0.502
Cutting, shortwall machine	0.080

Logan

Machine loading	0.412
Cutting, shortwall machine	0.062

Williamson

Machine loading	0.438
Cutting, shortwall machine	0.066

Big Sandy-Elkhorn

Machine loading	0.545
Cutting, shortwall machine	0.090

Hazard

Machine loading	0.482
Cutting, shortwall machine	0.090

Harlan

Machine loading	0.490
Cutting, shortwall machine	0.080

Virginia

Machine loading	0.488
Cutting, shortwall machine	0.077

The following hourly and day wage rates shall be paid in all mines in the Maryland and Upper Potomac district, including Grant, Mineral and Tucker counties of West Virginia; Kanawha; Logan; Williamson; Big Sandy-Elkhorn; Hazard; Harlan; and Virginia districts for the classification of occupations shown herein:

Classifications of Occupations	Hourly Rate	Day Rate
Inside:		
Motormen, rock driller	$0.680	$4.76
Drivers, brakemen, spraggers, snappers, coal drillers, trackmen, wiremen, bonders, timbermen, bottom cagers	0.657	4.60
Pumpers, trackmen helpers, wiremen helpers, timbermen helpers; and other inside labor not classified	0.623	4.36
Greasers, trappers, flaggers, switchthrowers	0.428	3.00
Outside:		
Bit sharpener, car dropper, trimmer, car repairmen, dumpers	0.548	3.84
Sand dryers, car cleaners, other able-bodied labor	0.514	3.60
Slate pickers	0.428	3.00

Skilled labor not classified to be paid in accordance with the custom at the mine.

Operators in the Southern Appalachian region accepted the provisions of the new Appalachian agreement on April 4. Day wage rates correspond to those in Schedule C of the general agreement. The new basic tonnage rates are as follows: loading, machine-cut coal, 51c. per ton; cutting, shortwall machine. 9c.

The text of the smokeless agreement is as follows:

Smokeless Wage Agreement

April 2, 1934

WAGE AGREEMENT BETWEEN THE SMOKELESS COAL BOARD REPRESENTING OPERATORS OF THE FIVE SMOKELESS PRODUCING DISTRICTS — NAMELY, POCAHONTAS, TUG RIVER, WINDING GULF, NEW RIVER, AND GREENBRIER — AND THE INTERNATIONAL UNION UNITED MINE WORKERS OF AMERICA, AND DISTRICT NO. 17, UNITED MINE WORKERS OF AMERICA.

This contract, made and entered into between the Smokeless Coal Board, representing producers of smokeless coal in the following districts: Pocahontas, Tug River, Winding Gulf, New River, and Greenbrier; party of the first part, and the International Union United Mine Workers of America and District No. 17, on behalf of itself and each of its members, parties of the second part. New districts may be established embracing this territory.

WITNESSETH:

First, it is agreed that this agreement is made and entered into pursuant to the provisions of Sec. 7 (b) of the National Industrial Recovery Act.

Second, the parties hereto further covenant and agree as follows:

That this contract is for the exclusive joint use and benefit of the contracting parties, as heretofore defined and set forth in this agreement; and it shall be construed as binding upon and effective in determining only the relations with each other of those represented by the parties signatory hereto. It is the intent and purpose of the parties hereto that this agreement will promote an improved industrial and economic relationship in the smokeless coal producing area embraced in this agreement and to set forth herein the basic agreements covering the rates of pay, hours of work, and conditions of employment to be observed between the parties hereto.

The prices and provisions of this contract shall apply to all mines in the smokeless producing district and in what is now known as District No. 17, operated by companies parties to this agreement.

It is understood and agreed by and between the parties hereto, that if the United Mine Workers of America negotiate a wage agreement or an agreement covering variations in working conditions, with any other person, association, or districts on a basis more favorable to such other person, association, or districts than the basis of this present wage agreement, then in that event the basis of this present wage agreement shall be modified so that the producers of smokeless coal in the five districts shall receive all of the benefits of such more favorable wage agreement, unless such agreement has been approved by the producers of smokeless coal represented by the Smokeless Coal Board.

MAXIMUM HOURS AND WORKING TIME

Seven hours of labor shall constitute a day's work. The seven-hour day means seven hours' work in the mines at the usual working places for all classes of labor, exclusive of the lunch period, whether they be paid by the day or be paid on the tonnage basis; except in cases of accident which temporarily necessitates longer hours for those mine workers required on account thereof; and also excepting that number of mine workers in each mine whose daily work includes the handling of man-trips and those who are required to remain on duty while men are entering and leaving the mine.

The seven-hour day, five-day week (35 hours per week), as provided in this agreement, shall prevail.

The following classes of mine workers are excepted from the foregoing provisions as to the maximum hours of work:

All mine workers engaged in the transportation of men and coal shall work the additional time necessary to handle man-trips and all the coal in transit, and shall be paid the regular hourly rate. Outside employees engaged in the dumping, handling and preparation of coal, and the manufacture of coke, shall work the additional time necessary, not to exceed 30 minutes, to dump and prepare the coal delivered to the tipple each day, and complete the usual duties incidental to the operation of coke ovens, and shall be paid the regular hourly rates. This rule shall not encourage the working of overtime except where it is absolutely necessary to take care of the conditions named.

When day men go into the mine in the morning they shall be entitled to two hours' pay whether or not the mine works the full two hours, but after the first two hours the men shall be paid for every hour thereafter by the hour, for each hour's work or fractional part thereof. If for any reason the regular routine work cannot be furnished inside day men, the employer may furnish other than the regular work.

Drivers shall take their mules to and from stables, and the time required in so doing shall not include any part of the day's labor, their work beginning when they reach the change at which they receive empty cars, but in no case shall the driver's time be docked while he is waiting for such cars at the point named. The method at present existing covering the harnessing and unharnessing of mules shall be continued throughout the life of this agreement.

Motormen and trip riders shall be at the passway where they receive the cars at starting time. The time required to take motors to the passway at starting time and departing from the same at quitting time shall not be regarded as part of the day's labor, their time beginning when they reach the change or parting at which they receive cars, but in no case shall their time be docked while waiting for cars at the point named. Motormen shall at all times take proper care of the motors and the customs as prevailing at each mine relative to greasing and oiling the motors and filling sand boxes and reporting on the conditions of the motors shall continue during the life of this agreement.

Employees engaged at power houses, substations and pumps operating continuously for 24 hours daily are especially exempted from the seven-hour day provision. Special exemptions for other individual employees than those named above, when 24 hours' continuous operation daily is required, are subject to arrangement between the mine management and district officers. Employees so especially exempted are limited to eight hours per day and 40 hours per week.

HOLIDAYS

The following holidays are recognized: New Year's Day, April First, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day.

BASIC TONNAGE RATE

In paying for coal before it is screened, it is not intended to encourage unworkmanlike methods of mining and blasting coal, or to decrease the proportion of screened lump, and any miner will be subject to discipline who, from ignorance, carelessness, or any other cause, fails to properly mine, shoot and load the coal. If required by the operator, the miner must block and clean out machine cuttings before shooting.

The basic rate for loading coal shall include the work required to drill, shoot, clean and load the coal, properly timber the working places in the mine, and all other work and customs incidental thereto,

and the operator shall be required to furnish the necessary props and timbers to properly timber all working places. Where necessary to set crossbars, the miner shall assist the timberman to the extent of the labor ordinarily required to properly timber a working place. When ordinary timbers, props, etc., are sent to the miner in mine cars in reasonable amounts he shall unload same.

Where the operator relieves the loader of any part of the regular work or expense required above, a lower piece rate as mutually agreed upon shall be established to compensate the operator for that additional expense.

Miners shall lay all temporary track and jumpers; also lay steel rails where steel ties are used. Where it is customary for the operator to lay all track, this practice shall continue during the life of this agreement. It is understood that track materials shall be delivered at as near as practicable to the miner's working face. The present custom of removing jumpers to enable machine to cut shall be continued.

It is understood that the miner shall be responsible for the care of all supplies sent to him for his use, and that he will recover all cars, turns, rails and ties in pillar drawing where possible. Mine cars shall be delivered to the miner at his working face.

Where the mine worker is required by a mine official to leave his work at the face to perform other labor he shall be paid at the rate of $4.60 per day. If he is called to perform labor where the scale rate is higher than $4.60 he shall be paid the scale rate.

Any change in mining methods or installation of equipment that relieves the mine worker of any of the above duties and increases his productive capacity shall be recognized and a piecework rate agreed to therefor properly related to the basic rate.

Where the shooting is done, a credit on the loading rate will be given the operator by agreement between the management and the district officers of the United Mine Workers.

The standard for basic tonnage rates shall be 2,000 lb. per ton.

All labor employed in gang work on conveyor or scraper mining shall be paid the motorman's rate.

Rejects

At mines where in order to maintain and improve the earnings of both the loaders and the cutters, and where it is impracticable to maintain loader earnings if all the impurities were removed underground, certain portions of these impurities are loaded and rejected either by hand or mechanical methods at the tipple. It is agreed that the question of these rejects be referred to the local mine committee, who shall, with the mine management, determine the amount and quantity, of rejects that reach the coal producers' tipples and cleaning plants and an adjustment shall be made in the tare weight of the mine cars sufficient to cover this amount and quantity. Should a disagreement ensue it shall be handled as any dispute arising under the contract.

Operators accepting this plan agree to eliminate the practice of docking for impurities. This, however, does not prevent proper disciplinary measures being used against those who wilfully persist in loading dirty coal.

Cleaning and Preparation of Coal

It is the purpose of both mine workers and operators to promote the loading of and payment for clean and merchantable coal, and the mine workers, the mine committee and the officers of the United Mine Workers of America pledge themselves to cooperate with the operators in the production of merchantable coal.

In case slate, bone, clay, sulphur or other impurities are loaded with the coal by the miner, the miner or miners so offending shall be subject on first offense to warning; for the second offense, to two days' suspension; and for the third offense within 30 days, five days' suspension or discharge, at the option of the mine management, provided that in malicious and aggravated cases, the mine management shall have the right to discharge for the first or any subsequent offense. The estimated weight of the impurities shall be deducted from the total weight of the contents of the car.

All machine cuttings that cannot be cleaned by the loader must be gobbed or handled in the customary manner at the mine, and the place thoroughly cleaned before coal is shot. It is also understood that while the place is being cut, machine helper will throw or place as much of such cutting as practicable in the gob.

All coal mined, drilled and blasted by the miners must be done in a practical and workmanlike manner and in accordance with the State mining laws and such company rules as are not in conflict herewith.

Checkweighmen

The mine workers shall have the right to a checkweighman of their own choosing to inspect the weighing of coal. Such checkweighman is to be selected from the employees at that mine.

Cars shall be tared at reasonable intervals and without inconvenience to the operation of the mine. Tare shall be taken of the cars in their usual running condition.

At mines not employing a sufficient number of men to maintain a checkweighman the weight credited to the mine workers shall be checked against the billing weights furnished by railroads to the operators, and on coal trucked from such mines a practical method to check the weights shall be agreed upon. Such weights shall be checked once a month.

The wages of checkweighmen will be collected through the pay office semi-monthly upon a statement of time made by the checkweighman, and approved by the mine committee. The amount so collected shall be deducted on a percentage basis, agreed upon by the checkweighman and clerk, from the earnings of the mine workers engaged in mining coal and shall be sufficient only to pay the wages and legitimate expenses incident to the office, except where the method of payment is otherwise mutually agreed to.

The checkweighman shall be permitted at all times to be present at the weighing of coal, also have power to checkweigh the same, and during the regular working hours to have the privilege to balance and examine the scales, providing that all such balancing and examination of scales shall only be done in such way and at such time as in no way to interfere with the regular working of the mine. It shall be the further duty of checkweighman to credit each mine worker with all merchantable coal mined by him on a proper sheet or book kept by him for that purpose. Checkweighmen shall in no way interfere with the operation of the mine.

It is understood that if the checkweighman is absent from his post for any purpose, the running of coal over the tipple will not be suspended during his absence.

In case a checkweighman is removed from office as such, either by expiration of term or for other cause, his status as an employee at the mine shall be the same as though he had not served as checkweighman.

Boys

No person under seventeen (17) years of age shall be employed inside any mine nor in hazardous occupations outside any mine.

Exemptions Under This Contract

The term mine worker as used in this agreement shall not include mine foremen, assistant mine foremen, firebosses, or bosses in charge of any classes of labor inside or outside of the mine; or coal inspectors, weighbosses, watchmen, clerks, or members of the executive, supervisory, and technical forces of the operators.

Management of Mines

The management of the mine, the direction of the working force, and the right to hire and discharge are vested exclusively in the operator, and the United Mine Workers of America shall not abridge these rights. It is not the intention of this provision to encourage the discharge of mine workers, or the refusal of employment to applicants because of personal prejudice or activity in matters affecting the United Mine Workers of America.

Day men must perform any class of work at the direction of the mine management, provided the scale rate is paid, and the individual is not asked to take a reduced rate of wages for the day. The company has the right to transfer day men to loading coal without question, provided he is given an average working place.

Mine Committee

A committee of three (3) mine workers, who shall be able to speak and understand the English language, shall be elected at each mine by the mine workers employed at such mine. Each member of the mine committee shall be an employee of the mine at which he is a committee member, and shall be eligible to serve as a committee member only so long as he continues to be an employee of said mine. The duties of the mine committee shall be confined to the adjustment of disputes that the mine management and mine worker, or mine workers, have failed to adjust. The mine committee shall have no other authority or exercise any other control, nor in any way interfere with the operation of the mine; for violation of this clause the committee or any member thereof may be removed from the committee.

If any day man refuses to continue at work because of a grievance which has or has not been taken up for adjustment in the manner provided herein, and such action shall seem likely to impede the operation of the mine, the mine committee shall immediately furnish a man or men to take such vacant place or places at the scale rate, in order that the mine may continue at work, and it shall be the duty of any member or members of the United Mine Workers of America who may be called upon by the mine foreman or mine committee to immediately take the place or places assigned to him or them in pursuance hereof.

The mine committee, or any member thereof, shall under no circumstances, go around the mine for any cause whatsoever, unless called upon by the mine foreman or by the miner or day man, who may have a grievance that he cannot settle with the mine foreman, and then only to investigate that grievance with the mine foreman and the employee involved.

Grievances must be taken up after work hours unless otherwise agreed to.

Members of the mine committee employed as day men shall not leave their places of duty during working hours, except with the permission of the mine management or in cases involving the stopping of the mine.

Settlement of Disputes

Should differences arise between the mine workers and the operator as to the meaning and application of the provisions of this agreement, or should differences arise about matters not specifically mentioned in this agreement, or should any local trouble of any kind arise at any mine, there shall be no suspension of work on account of such differences, but an earnest effort shall be made to settle such differences immediately:

First, between the aggrieved party and the mine management;

Second, through the management of the mine and the mine committee;

Third, by a board consisting of four members, two of whom shall be designated by the mine workers and two by the operators. Such a board shall be established for the Pocahontas-Tug River, Winding Gulf, New River and Greenbrier districts.

Should the board fail to agree, the matter shall be referred to an umpire to be selected by said board. The decision of the umpire in any event shall be final. Each producing district may appoint a commissioner who can act with a representative of the United Mine Workers of America for the purpose of adjusting disputes or settling grievances arising under the contract.

A record of all cases settled under this contract between the district representative of the United Mine Workers of America and the mine management or between the operator's commissioner and the district representative of the United Mine Workers of America shall be filed with the joint board of each producing district.

Pending the hearing of disputes the mine workers shall not cease work because of any dispute; and a decision reached at any stage of the proceedings shall be binding on both parties thereto, and shall not be subject to reopening by any other party or branch of either association except by mutual agreement.

Expense and salary incident to the services of an umpire shall be paid jointly by the operators and mine workers in each district.

Discharge Cases

When a mine worker has been discharged from his employment and he believes he has been unjustly dealt with, it shall be a case arising under the method of settling disputes herein provided. In all discharge cases, should it be decided under the rules of this agreement that an injustice has been dealt the mine worker, the operator shall reinstate and compensate him at the rate based on the earnings of said mine worker prior to such discharge, provided, however, that such case shall be taken up and disposed of within five days from the date of discharge, and provided further that the mine management may permit the man discharged to return to work pending the decision in the case without prejudice to either party in handling the case.

Illegal Suspension of Work

A strike or stoppage of work on the part of the mine workers shall be a violation of this agreement. Under no circumstances shall the operator discuss the matter under dispute with the mine committee or any representative of the United Mine Workers

of America during suspension of work in violation of this agreement.

Irregular Work

When any mine worker absents himself from his work for a period of two days without the consent of the operator, other than because of proven sickness, he may be discharged. If a man persists in working irregularly he may be discharged. When a machine runner or any employee upon whose work other employees are dependent, absents himself from work without giving advance notice to the mine foreman, he shall forfeit his position.

Safety Practice

Reasonable rules and regulations of the operator for the protection of the persons of the mine workers and the preservation of property shall be complied with. The practical application and the use of safety appliances is viewed with favor by the United Mine Workers of America.

The United Mine Workers of America also view with favor the formation of Dr. Holmes safety chapters.

Engineers' and Pumpers' Duties

When required by the management, engineers, pumpers, firemen, power-plant and substation attendants shall under no condition suspend work but shall at all times protect all the company's property under their care, and operate fans and pumps and lower and hoist men or supplies as may be required to protect the company's coal plant.

Shifts

The operator shall have the right during the entire period of this agreement to work all the mines, or any one or more of them, extra shifts with different crews.

When the mine works only one shift it shall be in the day time, but this shall not prevent cutting and loading coal at night in addition to the day-shift cutting and loading.

When it is necessary in any mine to call men to work on other days than those which the mine operates in order to rush headings for the development of working places, to keep pillar lines in proper condition, to maintain equipment in safe and efficient operating condition, clean up slate falls or repair trolley lines and such other work of like character that may interfere with the mine work the next operating day, to make the improvements to the mines such as track work that would ordinarily interfere with the operation, it is understood the management shall make such calls at its own discretion; provided, however, no man is required to work in any one week a greater number of hours than provided in the code.

Pay Day

Pay shall be made semi-monthly and at least twice each month.

Subcontracting

The practice of subcontracting and the hiring of back hands for the mining and loading of coal shall not be permitted. This section shall not prohibit a group of miners working gang work in isolated places where the compensation paid is not less than the prices provided for in this contract.

Machine Work

No extra compensation shall be paid either cutter or loader because of the direction of a working place with reference to the butts or faces, or because it is driven an angle therewith.

The cutter shall cut the coal as directed by the management. In bottom cutting, if the cutter leaves a sprag or a thick bottom in excess of the thickness as directed by the mine management, he shall be notified to remove the same, and should he fail or refuse, he shall be charged one dollar ($1.00) for each sprag and fifty cents (50c.) for each run of thick bottom for breast machine or its equivalent width, the same to be paid to the loader who shall remove the same.

All bottom coal must be taken up and loaded by the loader if required by the employer.

Each machine crew shall be required to keep the cutting up in the section designated. Machine territory shall be divided so that the territory designated for each machine may be cut normally in seven hours' time, and each machine crew shall be required to keep the cutting up in the section so designated. If for any reason this cannot be done in regular hours, they shall work sufficient overtime to insure all loaders having coal to load.

The machine men may be required to either remove bits from the chain or cutter head, or place a shield over the cutter head to make the machine safe to be moved.

Discipline

All questions of dispute shall be considered and finally disposed of as provided for in this contract.

The United Mine Workers of America recognize the very fundamentals upon which collective bargaining is founded is the strict observance of agreements by both parties to this contract. Local strikes will not be tolerated. Every member of the United Mine Workers of America under the jurisdiction of this agreement pledges himself to cooperate with and assist every officer of the organization of the United Mine Workers of America in preventing local strikes. Every officer of the United Mine Workers of America pledges himself to do everything possible to make this declaration effective.

Equal Turn

The operator shall see that an equal turn is offered each miner and that he shall be given a fair chance to obtain the same.

Other Conditions Not Specified

All terms and conditions not specified under this contract to continue as they now exist during the life of this contract except where changed by mutual consent.

Equipment and Machinery

The employer shall be entitled to the fullest use of all machinery and equipment at the mines.

Equipment-Loading Coal

The operator shall at all times be at liberty to load any transportation equipment whatsoever, regardless of ownership, and to sell and deliver such loaded equipment in any market, and to any person, firm, or corporation they may desire.

Coking Plants and Cleaning Plants

Proper local agreements shall be made to provide for the continuous operation of coking and cleaning plants. Agreements for the operation of coking plants shall be made locally.

Increased Costs

During the period of this agreement no deviation therefrom, and no change in customary working conditions other than herein required, shall be permitted or approved by the United Mine Workers of America which will, directly or indirectly, increase the cost of producing coal to the employer, or which will, directly or indirectly, decrease the rate of pay of the employees.

Loading Mine Cars

In case of loss in transit, the company shall not be held responsible, except where a wreck occurs.

Smithing

One-half of one per cent of the earnings of the coal loader shall be the charge of smithing. The operator agrees to use every effort to have the mine worker's tools repaired and sharpened with as little delay as possible; it being understood that there shall be no charge for blacksmithing unless the operator furnishes a blacksmith.

Explosives

All explosives, tools and supplies incidental to the mining of coal shall be furnished by the mine worker at his expense. The operators shall have the sole right to designate the kind, type, size, quality and quantity of explosives that shall be used in any shothole. Where operators sell explosives the explosives shall be furnished to the mine workers at cost, which is to include handling, transportation and insurance.

Electric Cap Lamps

When electric cap lamps are furnished by the operator, the charge shall not exceed eight (8) cents per day for each shift a lamp is used. Any damage to or breakage of the lamp shall be repaired by the operator and the cost thereof charged to the mine worker in whose possession the lamp was when the damage resulted.

House Coal

The price of coal for domestic use by employees shall be at the rate of $2.00 per month plus actual haulage charges from the mine.

In no case shall coal be taken from the mine cars or railroad cars, and may only be picked up from the tipple by special permission of the management.

Where employees live in other than company-owned houses, away from the plant, the charge shall be $2.00 per ton plus actual haulage charges.

Starting Time

The starting time of any mine worker of the mine or tipple shall be left exclusively to the management, and thirty minutes shall be taken for lunch period.

Funeral

On the day that death by accident occurs in a mine, for that day only the miners may cease work, but under no circumstances shall a mine be laid idle for a funeral. This is, however, not to prevent individuals from attending a funeral.

Burial Fund

At mines where burial funds are or may be established, adequate protection by surety bond shall be given to the funds of the burial fund, also the disbursements of moneys. Procedure shall be covered by bylaws that have been agreed to by the employees and the management.

At mines where agreed bylaws are already in effect, such bylaws shall continue.

Insurance

Parties to this agreement encourage group insurance for employees, but it shall not be made a requisite to employment.

Any disagreements or misunderstandings arising relative to the application of the insurance shall be referred to a committee composed of six members, three from the miners and three from the management.

Pick Mining

In accordance with local custom in each district, pick coal rates shall be the basic loading rate plus the shortwall cutting rate, except in the Pocahontas and Tug River districts, in which the basic tonnage rate only will apply. The basic tonnage rate shall also apply in other smokeless districts where conditions are identical with Pocahontas-Tug River by agreement between the mine management and the district officers of the mine workers.

Expiration of Contract

This agreement shall become effective April 1, 1934, and shall continue in effect until March 31, 1935.

Check-Off

The dues of the United Mine Workers of America, not exceeding one dollar ($1.00) per month, shall be checked off the wages of members of said organization by the operator at the rate of fifty cents ($0.50) per half month, and shall be remitted to the secretary-treasurer of the district, United Mine Workers of America, on the date of the regular pay day, or within three (3) days thereafter, for distribution to the branches of the United Mine Workers of America; and no other assessments shall be so checked off except upon the authorization of the international executive board of the United Mine Workers of America.

Initiation fees of the United Mine Workers of America, in sums not to exceed one dollar ($1.00) per man in any one pay period, shall be deducted by the operator and remitted to the financial secretary of the local union, United Mine Workers of America. Under no circumstances shall the initiation fee for any one man exceed ten dollars ($10.00).

Collection of dues and initiation fees shall be made from employees who in writing notify the mine management that they are members of the United Mine Workers of America, or applicants for membership.

Deductions for dues and initiation fees of the United Mine Workers of America shall follow wages of checkweighmen, accident and death benefits, rent, doctor, hospital and mining expense.

Penalties

Should any mine worker or mine workers at the mine cause the mine or part of the mine to shut down in violation of this rule, every employee at said mines, except those who continue to work, shall have deducted from his or their earnings the sum of two dollars per day for each part of a day they may remain idle. Should any operator or his representative lock the men out for the purpose of forcing a settlement of any grievance, or cause the mine to shut down in violation of this rule, he shall be fined two dollars per employee for each day or part of a day the mine is thus thrown idle.

All fines provided for in this agreement shall be automatically collected and any operator failing to collect such fines shall pay a penalty of four dollars for each employee subject to be fined. The proceeds of all fines arising under this clause shall be paid to such charities as may be agreed upon by the representatives of the coal company and the representatives of the employee. In no case shall any fine be refunded except by mutual agreement of the accredited representatives of the operators and the miners.

It is further agreed that where any employee enters suit in the civil court to collect any fines collected in accordance herewith, the employees who are parties to this

contract shall reimburse the operator for the expense incurred on account of such suit.

LABOR CLASSIFICATIONS AND DAY RATES

The following hourly and day wage rates shall be paid in all mines in the Greenbrier, New River, Winding Gulf and Pocahontas-Tug River districts.

INSIDE RATES	Rate per hour	Rate per day
Machine runners	$0.680	$4.76
Machine runners' helpers	0.657	4.60
Motormen	0.680	4.76
Brakemen	0.657	4.60
Rock drillers	0.680	4.76
Rock drillers' helpers	0.623	4.36
Driver, single	0.657	4.60
Drivers, double	0.657	4.60
Coal drillers	0.657	4.60
Trackmen	0.657	4.60
Track helpers	0.623	4.36
Timbermen	0.657	4.60
Timbermen helpers	0.623	4.36
Bratticemen	0.657	4.60
Bratticemen helpers	0.623	4.36
Wiremen and bonders	0.657	4.60
Wire and bond helpers	0.623	4.36
Pumpers	0.623	4.36
Bottom cagers	0.657	4.60
Bottom cager helper	0.623	4.36
Couplers	0.623	4.36
Trappers, flaggers and switchthrowers	0.428	3.00
Greasers	0.428	3.00
Dumper, inside	0.657	4.60
Dumpers' helpers, inside	0.623	4.36
Slate shooters	0.657	4.60
All other inside labor	0.623	4.36
OUTSIDE RATES		
Dumper	0.548	3.84
Car-dumper helpers	0.514	3.60
R.R. car droppers	0.548	3.84
RR. car cleaners	0.514	3.60
R.R. car trimmers	0.548	3.84
Blacksmith (first class)	0.743	5.20
Blacksmith (second class)	0.657	4.60
Blacksmith helpers	0.548	3.84
Car repairmen	0.548	3.84
Car repairmen helpers	0.514	3.60
Bit sharpeners	0.548	3.84
Sand dryers	0.514	3.60
Substation operators	0.514	3.60
Greasers	0.514	3.60
Slate pickers	0.428	3.00
Cripples, boys and old men	0.428	3.00
Lamp-house man	0.548	3.84
Lamp-house helpers	0.514	3.60
Tipple mechanics	0.548	3.84
Tipple mechanic helpers	0.548	3.84
Tipple operator	0.548	3.84
Hoisting engineer	0.657	4.60
Firemen	0.514	3.60
Carpenters	0.680	4.76
Carpenters' helpers	0.548	3.84
Masons	0.680	4.76
Washerman	0.548	3.84
Boomman	0.548	3.84
Electrician	0.680	4.76
Electrician helpers	0.548	3.84
Powerhouse engineers	0.680	4.76
Teamsters and truck drivers	0.514	3.60
Common able-bodied outside labor	0.514	3.60
Boys, unskilled outside labor	0.428	3.00
Aerial tramway operator	0.548	3.84
Slate-hoist operator	0.548	3.84
Steam-locomotive engineer	0.680	4.76

Timbermen cutting timber in the woods shall, in our opinion, come under the lumberman's code.

Where substations are isolated from the mines, present conditions of employment shall prevail.

The present rates for operators of mechanical motors for handling slate on the outside shall continue.

The above rates are minimum rates but it is agreed that present rates, if above these minimums, shall be increased forty cents per day.

SCHEDULE—BASIC RATES, POCAHONTAS-TUG RIVER DISTRICT

	Tonnage rates per 2,000 lb. run-of-mine coal
Machine loading	$0.437
Cutting, shortwall machine	0.055
Cutting, track machine	0.039

Yardage

In all mines the usual Pocahontas sulphur and bone shall be handled without compensation.

Where a parting or middleman occurs, in lieu of the usual Pocahontas bone, four inches of the parting or middleman shall be removed free; all over four inches shall be paid for at the rate of $0.065 per inch per lineal yard.

The usual drawslate in excess of four inches shall be paid for at the rate of $0.065 per inch per lineal yard.

Sand-rock top that requires drilling and shooting shall be handled by company men.

SCHEDULE—BASIC RATES ESTABLISHED IN WINDING GULF DISTRICT

	Tonnage rates per 2,000 lb. run-of-mine coal
Machine loading	$0.464
Cutting, shortwall machine.	0.080
Cutting, track machine	0.056

Yardage Rates—Wide Work Over 1½ Feet

Where top or parting comes down with the coal, nothing will be paid for handling up to and including 4 in. in thickness. Over 4 in. the rate will be 6.5c. per inch in thickness per lineal yard.

Nothing will be paid for the first 4 in. regardless of thickness. Where the top or bottom is shot for headroom, 6.5c. per inch in thickness per lineal yard will be paid for all so shot and removed.

Narrow Yardage Under 1½ Feet

Where top and/or bottom is shot and removed for headroom 9.2c. per inch of thickness per lineal yard will be paid for all slate so shot and removed. Where top or parting comes down with the coal, nothing will be paid up to and including 4 in. For all over 4 in. the rate of 6.5c. per inch of thickness per lineal yard will be paid. Nothing will be paid for the first 4 in. regardless of thickness.

The above rates for yardage in both wide and narrow work will apply to top, bottom or parting, whether loaded out or gobbed.

The loading rate includes the customary cleaning of the average bone in the Winding Gulf field of 3 in. to 4 in. in thickness.

SCHEDULE — BASIC RATES ESTABLISHED IN THE NEW RIVER FIELD

	Tonnage rates per 2,000 lb. run-of-mine coal
Machine loading	$0.522
Cutting, shortwall machine.	0.085
Cutting, track machine	0.059

Yardage in Rooms

Where top or parting comes down with the coal, nothing will be paid up to a thickness of four inches; over four inches, the rate per inch per lineal yard to be $0.065 (nothing to be paid up to four inches regardless of thickness).

Where top and/or bottom is shot for headroom, yardage will be paid at the rate per inch per lineal yard for all thickness taken, $0.065.

Entry Yardage

Where top and/or bottom is shot for headroom, a slate yardage will be paid at the rate per inch per lineal yard for all slate shot full width of entry, $0.105.

Where top or parting comes down with the coal, nothing will be paid up to a thickness of four inches; over four inches the rate per inch per lineal yard, $0.065. (Nothing will be paid for the first four inches regardless of thickness.)

The above rates for yardage both room and entry applies to top, bottom or partings either gobbed or loaded out.

Water Yardage

Water yardage will be discontinued. When a miner performs labor to handle water, he will be compensated at rates applied by local management.

SCHEDULE—BASIC RATES ESTABLISHED IN THE GREENBRIER DISTRICT

	Tonnage rates per 2,000 lb. run-of-mine coal
Machine loading	$0.472
Cutting, shortwall machine.	0.065
Cutting, track machine	0.045

Yardage

Six inches of impurities or drawslate included in loading rate; and 5.2c. per inch per lineal yard thereafter.

In witness whereof, each of the parties hereto, pursuant to proper authority, has caused this agreement to be signed.

SMOKELESS COAL BOARD—P. C. Thomas, president; C. B. Smith, vice-president; H. C. Faust, secretary; W. G. Crichton, Edward Graff, R. J. Burmeister, L. T. Putman, M. L. Garvey, P. P. Kerr, R. E. Salvati.

UNITED MINE WORKERS OF AMERICA—John L. Lewis, president; Philip Murray, vice-president; Thomas Kennedy, secretary-treasurer; Van A. Bittner, president, District No. 17; William Blizzard, vice-president, District No. 17; J. H. Carter, J. V. Riffe, A. J. Bryant, W. E. Crago, Monroe Salmon.

Work Sharing Proposed to Solve Anthracite Unemployment

Reasonably equitable sharing of income during slack times to be secured by whatever methods will place the least additional burden on costs and offer the least interference with development was recommended as offering the most immediate possibilities of alleviating the unemployment problem in the anthracite industry in a report filed on April 6 by a U. S. Labor Department committee which investigated conditions in the western middle and southern anthracite fields in February and March. In this connection, the committee expressed the belief that equalization results in less human misery with a decrease in volume than concentration of operation at certain collieries and that the principle should therefore be included in the anthracite code.

Five other measures for relief suggested by various interests were listed by the committee as follows: rotation of work; limitation of certain operating methods (central breakers, mechanical mining, stripping and washery operation); emergency limitation of hours, which would result in a direct reduction in weekly wages; forced leasing or selling of closed collieries; and unemployment insurance, which the committee felt might be worth while as a supplement to equalization. However, possibilities of a permanent surplus of workers exist, the committee found, and to take care of this surplus it suggested the establishment of subsistence homesteads and the stimulation of manufacturing in the anthracite region.

Anthracite's Goal Outlined

Not just weather—or a few ads—can rebuild anthracite tonnage. What is needed is an enlightened merchandising policy providing for a maximum cooperation between all interests in the industry, declared Thomas Dickson, of Dickson & Eddy, in an address on "Going Forward With Anthracite," at the meeting of the Anthracite Club of New York, April 18. Collective merchandising efforts by the whole industry, rather than lone-wolf policies, are the inevitable way back to anthracite's rightful volume, as well as the lowest-cost way. Gains lie not only in recapturing tonnage lost to oil, coke and gas but also in creating new tonnage by selling the timely economy of anthracite.

Price isn't all that anthracite has to sell (oil and gas have proved that), and the industry must recognize that larger sizes must come down and stoker sizes must come up at least enough to carry their mining costs. Junior sizes will be readily absorbed at more favorable prices when organized and planned marketing are employed to supplement the stoker builder's efforts. Equipment rather than the fuel itself built the market for oil, and this trend toward labor-free heating requires anthracite-burning equipment that can compete on an equal or better basis. The successful anthracite dealer of tomorrow will be closer to his trade than by telephone and will relate his business and services to coal-

burning equipment. Improved profits for the retailer must be developed through planned cooperative efforts to enable him to reduce costs as well as rebuild his volume, and in this the dealer must help by stamping out excessive margins.

Board Hears Code Complaints; Adopt Statistics Plan

The National Recovery Review Board, formed as a result of charges that small enterprises were being discriminated against under code operation, took up the bituminous code at hearings on April 11 and 12. After disclaiming jurisdiction over the controversy between the United Mine Workers and the Progressive Miners of America in Illinois, the board heard complaints by the Sardis Coal Co. against rulings of the northern West Virginia subdivisional code authority in which company representatives alleged that the setting of the same price on its coal as on higher-quality coal had killed its markets, and by the Lowber Gas Coal Co. against the washed-coal differential established by the western Pennsylvania subdivisional code authority, which was declared to be so small in certain cases (5c. per ton) as to eliminate most of the company's market for unwashed coal.

Continuation of the collection of statistical data on code operation was the subject of a three-day conference in Washington, April 18-20, which was attended by representatives of the country's major producing districts. The conference was understood to have agreed on the discontinuance of Forms B and D, with some exceptions, and the modification of Forms A and C for the purposes of simplification. Data will be gathered to Dec. 1, 1934, it is contemplated, Form A to be on a monthly basis and Form C on a semi-monthly basis from May 1. Payment for the major portion of the work is expected to be borne by the industry, which is offered the choice, according to tentative arrangements, of collecting the information through divisional or subdivisional organizations under the supervision of NRA or through NRA itself.

Two subdivisional code authority elections were held in the early part of April. All members of the Southern subdivisional code authority No. 2 of Division I (*Coal Age*, November, 1933, p. 390) were reelected with the exception of C. M. Moore, Moore Coal Co., who is succeeded by W. G. Polk, Tennessee Jellico Coal Co. Organization of the Illinois subdivisional code authority, Division II, was completed for the coming year in April by the election of the following officers: chairman, George W. Reed, Peabody Coal Co.; vice-chairmen, W. J. Jenkins, Consolidated Coal Co. of St. Louis, and Hubert E. Howard, Binkley Coal Co.; treasurer, A. B. Steffens, Indiana & Illinois Coal Corporation; executive secretary, B. R. Gebhart.

S. M. Thompson, president, Caliente Coal Co., Walsenburg, Colo., was named employer representative on the Division V Bituminous Coal Labor Board in April, succeeding D. D. Muir, Jr., resigned.

Personal Notes

Joseph Bennett, formerly in charge of coal purchases for the Illinois Central R.R., has been placed in charge of the Indiana operations of the Crescent and Sunnyside coal companies, with headquarters in Evansville.

Otto Herres, Jr., assistant general manager, United States Fuel Co., Salt Lake City, Utah, was elected president of the Utah Coal Operators' Association in April, succeeding J. B. Marks, vice-president and general manager, Independent Coal & Coke Co.

William Johnson, for several years face boss at the Zeigler No. 2 mine, Bell & Zoller Coal & Mining Co., has been appointed State Mine Inspector of the Tenth Illinois District. Joseph Firth, Jr., Benld, also has been named a mine inspector, and the following new mine-rescue station superintendents have been appointed: Belleville, Arthur Bradbury; Benton, Ray Williams; Johnston City, Houston V. Webb.

Clarence E. McGhee, Minersville, Pa., for many years division engineer for the Philadelphia & Reading Coal & Iron Co., superintendent of the Otto colliery and later head, Schuylkill County engineering staff, resigned last month to accept a position as superintendent of the West End Coal Co. operations at Mocanaqua, Pa.

D. D. Muir, Jr., vice-president and general manager, United States Fuel Co., Salt Lake City, has been made vice-president in charge of Western operations of the United States Smelting, Refining & Mining Co., with headquarters in Boston, Mass.

Lee Ott, formerly West Virginia State Compensation Commissioner, has been appointed acting general superintendent of the West Virginia Coal & Coke Corporation operations, Omar, W. Va., in the absence of Lafayette Tuck, on leave because of illness.

A. C. Richardson, formerly with the Southern Experiment Station, U. S. Bureau of Mines, Tuscaloosa, Ala., has been appointed to the technical staff of the Battelle Memorial Institute, Columbus, Ohio, and will work under the direction of Byron M. Bird, chief concentration engineer.

Industrial Notes

Robins Conveying Belt Co., New York and Chicago, has appointed the following sales agents: Fred Bathke, 1957 University Place, St. Paul, Minn., for Minnesota, western Wisconsin and northwestern Michigan; and Raymond Church, Pleasant Ridge Station, Cincinnati, Ohio, for southwestern Ohio, southwestern Indiana and western Kentucky.

Macwhyte Co., Kenosha, Wis., has removed its Pittsburgh (Pa.) office and warehouse to the Rea Building, 704 Second Ave.

Moorhead-Reitmeyer Co., Inc., Pittsburgh, Pa., has removed its sales offices to the Columbia Building, 4th Ave. and Wood St.

Stephens-Adamson Co., Aurora, Ill., has reopened its sales and engineering offices at Huntington, W. Va., with D. W. Allen, tipple and conveyor expert, in charge, and at 1206 Gulf Building, Pittsburgh, Pa., with Harry W. Banbury, former purchasing agent and special sales engineer, in charge.

David Adams has been appointed Pittsburgh (Pa.) district sales manager for the Falk Corporation, Milwaukee, Wis., succeeding W. O. Beyer.

Marr - Galbreath Machinery Co., Pittsburgh, Pa., has moved to larger quarters at 55 Water St.

Obituary

James A. Emmons, 41, president, Emmons Coal Mining Co., Inc., died at the University Hospital, Philadelphia, Pa., April 16, after an illness of four months.

Oscar E. Neff, treasurer, Lehigh Coal & Navigation Co., died at the Chestnut Hill Hospital, Philadelphia, Pa., April 15, of a cerebral hemorrhage. Mr. Neff joined the company in 1904 as a clerk.

Mine Fatality Rate Rises

Coal-mine accidents caused the deaths of 79 bituminous and 30 anthracite miners in February, 1934, according to information supplied the U. S. Bureau of Mines by State mine inspectors. This compares with 60 bituminous and 25 anthracite fatalities in January. Based on a production of 31,970,000 tons, the bituminous death rate was 2.47 per million tons in February, against 1.82 in January, when the output was 32,916,000 tons. The anthracite death rate rose from 4.08 in January, when 6,125,000 tons was mined, to 5.04 in February, when the production totaled 5,952,000 tons. For the two industries combined, the February death rate was 2.87, against 2.18 in January.

Homestead Project for Illinois

Establishment of a subsistence homestead project at West Frankfort, Ill., was announced by Secretary of the Interior Ickes last month. The new project will embrace 275 homes at a cost of $500,000, and will draw its population from both unemployed coal miners and factory workers in the territory.

Coming Meetings

American Management Association; insurance conference, May 14 and 15, Atlantic City, N. J.

Illinois Mining Institute; annual boat trip and summer meeting on Str. "Cape Girardeau," leaving St. Louis, Mo., 8 p.m., June 8, and returning June 10.

Colorado and New Mexico Coal Operators' Association; annual meeting, June 20, Boston Building, Denver, Colo.

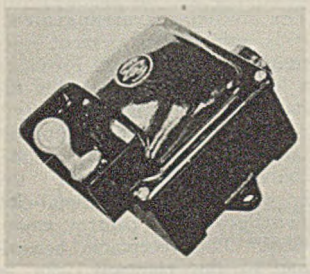
National Retail Coal Merchants' Association; annual meeting, June 18-20, Willard Hotel, Washington, D. C.

Indiana Coal Producers' Association; annual meeting, June 12, Terre Haute, Ind.

WHAT'S NEW
IN COAL-MINING EQUIPMENT

Pushbutton

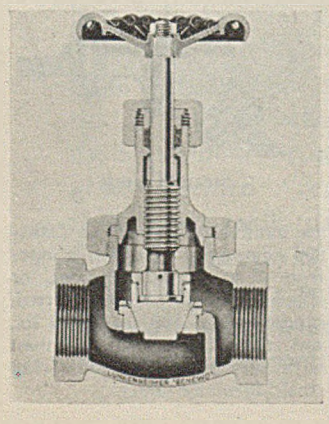
For use in connection with the remote control of automatic motor starters, Electric Controller & Mfg. Co., 2705 East 79th St., Cleveland, Ohio, offers the 270-A, Type J, Form C, vaporproof and dust-tight, safety lock-out pushbutton for three-wire, low-voltage-protection installations where it is desired to start and stop a motor



through its magnetically operated starter or controller from two or more pushbutton-control stations, at any of which it may be desired to lock the button in the "off" position to prevent operation of the machine. Insertion of a padlock on the "stop" side of any one of these pushbuttons will prevent operation of the machine until the lock has been removed and the control circuit established by an authorized person.

Valves

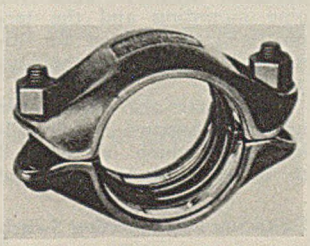
Lunkenheimer Co., Cincinnati, Ohio, has developed "Renewo" and "Ferrenewo" valves with plug-type "NS5" alloy seats and disks for severe service demanding maximum resistance to destructive action on

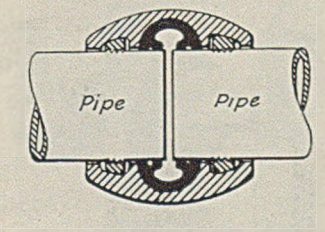


valve-seat bearings. The alloy, according to the company, is a non-galling, non-ferrous composition of great hardness (300 Brinell) said to retain its hardness at high temperatures and to have high resistance to wear, abrasion, erosion and corrosion. Iron-body, bronze-mounted "Ferrenewo" plug-type valves are available for 150-lb.-per-square-inch steam; bronze "Renewo" valves for 200- and 300-lb.-per-square-inch seam. Excepting bodies and bonnet rings, all parts of "Ferrenewo" and medium "Renewo" valves are interchangeable. This feature also applies to the various patterns of the extra-heavy "Renewo" type.

Gasket-Type Coupling

Champion Machine & Forging Co., Cleveland, Ohio, offers the new Champion "Positive Seal" gasket-type drop-forged pipe coupling for joining straight, plain-end pipe without grooving, threading, beveling or upsetting the ends, no extra finishing operation being necessary.





Tests, according to the company, show an efficiency in tension in excess of threaded and coupled joints, and the gasket is designed to provide a double seal effective against either pressure or vacuum. Two special steel reinforcements protect the gasket from the pinching action of the two halves of the coupling when it is being assembled on the pipe.

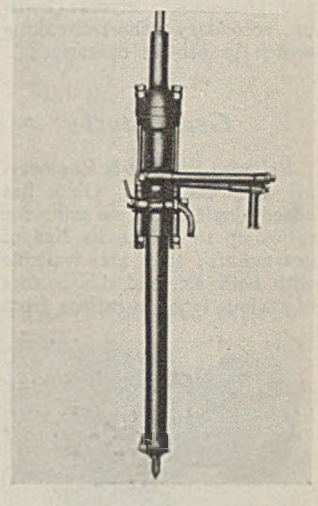
Two half sections containing gripping devices, one gasket with metal-protected sections and two bolts comprise the coupling, which, the company states, allows joints to be made with unskilled labor; permits joints to be made and broken any number of times without impairing the efficiency of the coupling; and allows assembly of the coupling on the same or new pipe without inconvenience.

Hard Surfacing

Gunite Foundries Corporation, Rockford, Ill., offers the "Electriding" process for converting the surface structure of malleable or gray iron into a hard carbide structure with a Rockwell C hardness of 42 to 45 and a Brinell hardness of 350 to 375 to depths of $\frac{1}{16}$ to $\frac{1}{8}$ in. without affecting the malleability of the cast material underlying the hardened skin. The process is recommended by the company for digging tools, brake shoes and other equipment subject to wear, and is said to be relatively inexpensive. It also can be used, it is said, in connection with castings containing temper or graphitic carbon, as found in malleable or gray iron.

Rock Drill

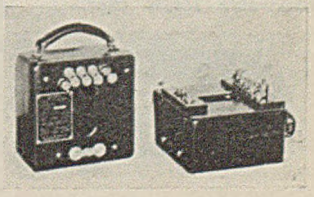
Ingersoll-Rand Co., Phillipsburgh, N. J., offers the new "N79 Stopehamer" drill for general mine work in hard rock. Weight is 99 lb.; length, feed closed, 54½ in.; length, feed extended, 74½ in.; diameter of air feed, 2½ in.; solid hexagon or quarter-octagon steel, without shanks, ⅞ or 1 in. Features pointed out by the company include: use of air pressure to keep cuttings out of front head and prolong life of drill; elimination of springs through full air-cushioning of the piston, thus eliminating movement of joining surfaces; long bearing to assure increased life of anvil block and cylinder front washer and maintain anvil block in proper alignment; automatic lubricator and pushbutton for air feed in rotating handle; intermediate lugs on large-diameter, one-piece throughbolts pre-



vent back of drill coming apart when changing front heads; light, sensitive and positive flapper valve protected from injury assures high drilling speed; well-supported, reversible piston to give added service; simple, single-tube construction, no blower tube necessary; large bearing faces to reduce wear at joints; positive, durable and efficient air-feed piston construction; renewable bearing with long-wearing surface.

Portable Current Transformers

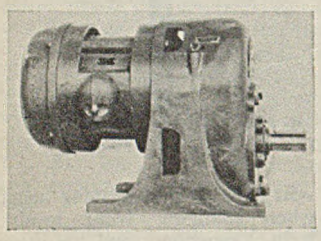
Esterline-Angus Co., Indianapolis, Ind., offers a new portable current transformer for use with indicating and recording instruments. Nine primary current ranges are available: 10, 12.5, 25, 50, 100, 160, 200, 400 and 800 amp. Secondary capacity is 5 amp., adapting the transformer to use with all standard a.c. ammeters, wattmeters and power-factor instruments, it is said. Other features pointed out by the company are: volt-ampere rating 25, with compensation for a load of 15 volt-amperes, enabling the transformers to operate several in-



struments simultaneously at high accuracy; insulation for use with voltages up to 2,500; cast aluminum case to withstand rough usage; moisture removed from windings and case filled with insulating compound to permit equipment to be used in damp places in mines and elsewhere; weight 28 lb.; cores proportioned to give low ratio and phase-angle errors; built-in secondary short-circuiting switch to protect operative.

Gearmotors

Reliance Electric & Engineering Co., Cleveland, Ohio, has added single-reduction units for ratios up to 6:1 to its line of gearmotors; they are available with both a.c. and d.c. motors of various types in ratings from



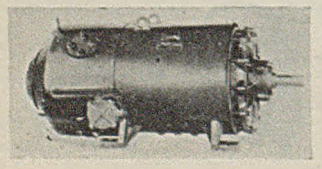
¾ hp. up. Multi-speed and adjustable-speed motors may be used, according to the company, which states that the entire reduction is obtained in a single pair of gears.

Protective Coating

"S.R.P." metal-protective coatings are offered by L. Sonneborn Sons, Inc., 88 Lexinton Ave., New York, for checking corrosion and rusting on metal surfaces. One feature, according to the company, is their adaptability to application over rusty surfaces without any previous preparation, checking further corrosion and forming a permanent protective film. The coatings, it is asserted, also withstand acids, alkalis and other corrosive elements.

Explosion-Proof Motor

Louis Allis Co., Milwaukee, Wis., has added a direct-current, fan-cooled model to its line of explosion-proof motors. Features include, according to the company, quick and easy inspection of the commutator and brushes by three quickly removable screw caps.



Chain Hoist

Wright Mfg. Division, American Chain Co., Inc., York, Pa., offers a new chain hoist with improvements said to increase durability, efficiency and usefulness. Features outlined by the manufacturer include: zinc coating of all exposed parts to adapt the equipment to moist or corrosive atmospheres; use of precision ball bearings with integral grease seals to support all moving parts, thus increasing efficiency 10 per cent over previous models; continuous lubrication to reduce wear to a minumum; hardened pawl tip; improved load chain guard; and ball-spring covers on oil tubes.

Wood Preservative

Tennessee Eastman Corporation, Kingsport, Tenn., offers "No-D-K," a highly concentrated creosote oil for protecting wood from decay and insect attacks. It may be applied by dipping, spraying and brushing, and the company points out the following features: harmless to the skin; attractive brown finish; permanence (will not crack, chip or peel off); high boiling point, preventing evaporation in the sun; insolubility in water; and adaptability to application by unskilled labor. Applications noted by the company include tipples, trestles, timber, ties, poles and crossarms, houses and other exposed woodwork.

Tractor

Low first cost, ability to operate on inexpensive fuels and the power savings of track-type traction are among the major advantages claimed for the new Caterpillar "22" tractor announced by the Caterpillar Tractor Co. The new model is powered by a 4-cylinder engine developing 23.69 hp. on the drawbar and 28.39 hp. on the belt at the governed speed of 1,250 r.p.m. Twin tanks hold 20 gal. of tractor fuel and 3 gal. of gasoline for starting. The "22" model is available in either standard- or wide-gage models. Shipping weight of the standard machine is 6,150 lb.

Lead Packing

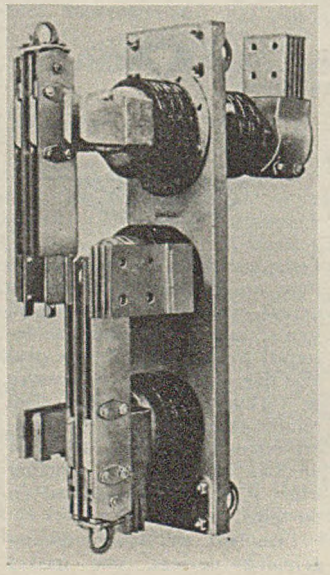
Armite Laboratories, Los Angeles, Calif., offers a new metallic lead packing for severe operating conditions bearing the name "Plastic Bestolife." It consists of an intimate mixture of long-fiber asbestos, cotton, finely divided metallic lead and a lubricant in such proportions as to form a metallic lead seal in pump and valve stem glands under ordinary gland pressures. In service, a fine, uniform metallic-lead film forms on the contact surfaces, according to the manufacturer, materially reducing friction and decreasing leakage, even where the shaft is badly corroded. As the metallic lead content is approximately 70 per cent, a dense metallic ring is formed, which is said to have all the advantages of a solid ring but requires less pressure to keep it tight, due to the fact that it consists of a fine paste. Asbestos and cotton act as the binder, so that it remains unchanged as a block lubricant, even under tremendous pressures, it is pointed out. Minimum pressure is required to stop leaks, and packing life is unusually long, it is asserted. The packing is available in two grades: No. 285, for water, acids, alkalis and salines; No. 286 for gas, oil and petroleum products.

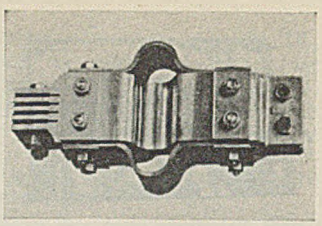
Electrical Aids

Delta-Star Electric Co., Chicago, announces a new 4,000-amp., 7½-kv., single-pole, double-throw, front-and-back-connected, transfer selector switch with 90-deg. blade stop and blade locks. The nonmagnetic supporting base is provided with U bolts for pipe mounting and the terminals are arranged for direct bolt conection to the copper buses.

Delta-Star also offers the new bus expansion joint illustrated, which is designed to connect 4¼x4-in. vertical

Delta-Star Disconnecting Switch.

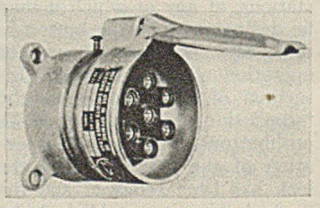




Bus Expansion Joint.

bars to horizontal bars with the same dimensions. The symmetrical square-shaped arrangement of the laminations, according to the company, makes it possible to connect bars in the same plane or in planes at right angles to each other. Laminations in the vertical plane are turned in toward the center to give a maximum phase clearance to the next joint. The box-shaped arrangement, it is said, gives perfect current distribution and provides a joint of very reasonable dimensions for high capacity.

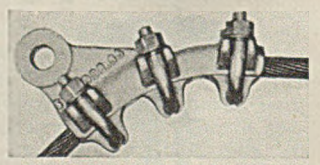
Another Delta-Star product is the new heavy-duty, multi-contact receptacle for use in connection with metal-clad switchgear and control equipment. This receptacle, according to the company, can be bolted flat against an opening in the metal housing inclosing the control wiring, thus giving



Delta-Star Receptacle

a direct connection with minimum space requirements. It is made with 3, 4, 5, 6 or 7 poles and all except the 3-pole type are polarized.

Delta-Star also offers a new strain and dead-end clamp for industrial and pole-top service, operating on the principle of compression and distortion of the cable strands. Four sizes



Strain Clamp

are available from 1/0 to 2,000,000 circ.mils; weight ranges from 3 to 11 lb. Pullout, or slippage values, it is asserted, range from 6,550 to 18,600 lb., and the clamps can be used with clevis or ball-and-socket strain-insulator units.