COAL AGE

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

SYDNEY A. HALE, *Editor*

New York, August, 1935

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Waste Coal Products

AMONG projects which might be suggested for research is the obtaining from waste coal of what familiarly are known as byproducts. Certain impurities are known to increase by-product yield, and, pursued at the mine, the distillation of impure coal for its "byproducts" might be profitable. The coke obtained might be valueless except for boiler use or salable only locally, but the catalytic action of the impurities might make the venture profitable, if the chemicals were processed at the mine.

The aim being to get chemicals, not coke, the distillation would be conducted without regard to the temperature desirable to make coke, or near-coke, or a product with an ash that would slag at high temperature, and catalytic substances could be added if need be. Perhaps the dirtier the coal the better the product, but this would be a matter of local determination. Such catalytic agents include certain kinds of shales and perhaps bituminous shales, with which the coal fields of the East abound.

Silicosis Prevention

SILICOSIS is a disease which takes some years to develop, especially where the conditions are not severe, the workmen are not mouth breathers and ventilation is good. If it should be made compensable, it may well happen that operators may have to pay for many prior years of exposure. No correction of conditions of working established after that date will be able to avert the result of years of uncorrected operation. It, therefore, is desirable to awake early to its possibility and to remove the causes before they become compensable and before the disease reaches the compensable point or becomes aggravated by tuberculosis. Particular attention should be given to the effect of blasting, which raises more dust than drilling. Where roadways and chutes are being driven in siliceous rocks, studies should be made on the possibility of using sprays with dust-wetting compounds that will cause immediate deposition of the fine dust.

Bootlegging

EVILS ONCE ESTABLISHED soon involve so many persons as to be almost impossible to correct. When coal bootleggers were few, a little policing might have ended their operation. But once bootlegging became a vested interest in which hundreds were engaged, and in which they had acquired skill and had expended their entire, even if meager, capital, any effort to suppress their activity became difficult. One large anthracite company, thus far troubled only by the illicit competition of the bootlegger, quite wisely decided to nip bootlegging in the bud on its properties by stopping the practice before it became established. To let it run and then attempt to limit or suppress it is nothing short of suicidal.

Race With Death

MEN who like to flirt with death always will be found; hence, we have gymnasts, human flies, steeplejacks, steel erectors—and snappers. Only a few men are needed for the perilous work of throwing switches and opening doors ahead of a locomotive, so the number of them and their accidents usually are not recorded; but every mine should keep a record of accidents to snappers per thousand man-hours of employment.

If the gruesome work of the snapper were absolutely necessary it might be well for comfort of mind and soul to hide the record by grouping it with relatively safe jobs around

the mine, like digging ditches or loading coal. But his flirtation with death that too often ends with the poor fellow tripping and falling and injuring himself, or being rolled over, or even crushed by the oncoming locomotive, is entirely needless. Remote mechanically operated switches and/or electric switches operated by a pull of the motorman's hand or by the passage of the locomotive itself will do the work and will eliminate the race with death, or the feverish effort to climb aboard in a low place on cars traveling at a high velocity. Motormen may develop the speed mania. It is a species of horseplay to give the snapper a "run for his money," to scare him a little, especially if he is a greenhorn, and to push him to the limit if he is an old hand. The snapper makes his wager not only with death but with his fellow motorman. It is a game both like to play.

But it must end if safety is to be the first consideration, and electric or remote mechanical operation of switches will eliminate it. Some men who value their lives refuse to expose them to this useless gamble, and it is a senseless thing for those who advocate safety everywhere else to wink at this hazard, which serves as an excitation to take other and forbidden hazards that appear and are far more excusable. With electrification everywhere, switch opening and closing should be electrical wherever trips are switched without stopping the locomotive. Rules made requiring the locomotive to come to a full stop are seldom obeyed, for a trip stopped on a curve is started with difficulty, draws heavily on the electric circuit, causes power peaks and throws out circuit breakers, for which difficulty electric switch throwing is the natural corrective.

Ventilation Losses

In Cape Breton the coal beds have been extracted several miles under the sea until the average distance from the water line is 2.95 miles. As it is impossible to sink shafts in the sea, it is necessary to bring the air back to the shore, making its travel excessively long. To reduce this distance and to avoid having intakes and returns near one another, the air is taken down one slope and returned up two other slopes a mile or more away on either side of the intake airways. Thus the air does not have to return along the levels but goes once along them and out at the distant slope. Both the original intake and the original return are available as intakes, and there is no leakage.

This saving in distance has done much to decrease the resistance of the mine to the passage of the air current. Most mines could provide shafts or drifts to the surface at some remote point and make an even greater saving in resistance, but from force of habit or lack of forethought, the air continues to be circulated, doubling the distance, using cluttered back-airways for returns that should be used as intakes, causing needless leakage and resulting in waste of power or inadequate ventilation.

Exciting, But—

Unless the latest conference of the Appalachian joint sub-scale committee smashes the deadlock of earlier meetings, the country probably will be treated to another last-minute temporary extension of the wage contracts originally scheduled to expire last March. The first truce, staying the threat of a general suspension of bituminous mining until June 16, was an act of industrial statesmanship that reflected high credit upon the industry. If the subsequent extensions were slightly less glamorous, nevertheless they had the positive virtue of withholding action which could and still would be injurious to the public and disastrous to the industry.

No real progress toward further stabilization can be made, however, while the continuance of existing labor relations depends upon the uncertainties of zero-hour truces. Moreover, there is real and recurring danger that some of the actors in the stirring drama may forget their lines at a climactic moment and plunge the industry into a crisis from which extrication without serious damage would be difficult. Worse still, the public may grow weary of the present stategy to promote legislation which contains no pledge against future suspensions and stage a strike of its own against both operators and mine workers. Under these circumstances, speedy negotiation of new wage agreements or extension of the old for at least the rest of the present coal year would seem to be the wise course. Such action would provide one sorely needed stabilizing factor at a time when the gains of the past two years are being jeopardized by internal disagreements and bickerings.

SEALING OF COAL MINES

+ Will Reduce the Acidity Of Their Effluent Waters

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Earth Dam and Weir Box Seal by Raising Water Level.

SINCE 1928 the United States Bureau of Mines has directed attention to the benefits to be derived from sealing abandoned mines and worked-out sections of active mines. Sealing lessens stream pollution and also reduces losses and expense from corrosion of equipment handling acid mine drainage.[1] The effect of sealing is to exclude air from contact with the ferrous sulphide, ordinarily called pyrite, occurring in coal, and particularly in the strata immediately above and below the coal beds, and so prevent oxidation of the pyrite to sulphate. In later years others[2] have supplied considerable data and information. Probably the most important recent contribution to previous information, certainly that of most recent general interest, is the sealing of abandoned coal mines under the program of the Civil Works Administration for unemployment relief.

[1]Leitch, R. D., and Yant, W. P.: "A Comparison of the Acidity of Waters From Some Active and Abandoned Mines," U. S. Bureau of Mines Report of Investigations 2895, 1928, 8 pp. Leitch, R. D.: Yant, W. P., and Sayers, R. R.: "Effect of Sealing on Acidity of Mine Drainage," U. S. Bureau of Mines Report of Investigations 2994, 1930, 11 pp. Leitch, R. D.: "A General Review of the United States Bureau of Mines Stream Pollution Investigation," U. S. Bureau of Mines Report of Investigations 3098, 1931, 7 pp. "Sealing Abandoned Mines as a National Industrial Recovery Act Project," U. S. Bureau of Mines mimeographed report, August, 1933, 8 pp.

[2]Stevenson, W. L.: "Coal-Mine Drainage Disposal," Proc. Third International Conference on Bituminous Coal, Carnegie Institute of Technology, 1931, II, pp. 913-920. Harris, Wesley S.: "Controlling the Acidity of Mine Water by Sealing," Indiana Coal Mining Institute, February, 1932. Carpenter, Lewis V., and Herndon, L. K.: "Acid Mine Drainage From Bituminous-Coal Mines," Research Bulletin No. 10, Engineering Experiment Station, West Virginia University, September, 1933, p. 13. Van Zandt, H. M.: "Impounding Mine Water to Reduce Acidity in the Coal Mines of Western Pennsylvania," Proc. Coal Mining Institute of America, 1933 (in press).

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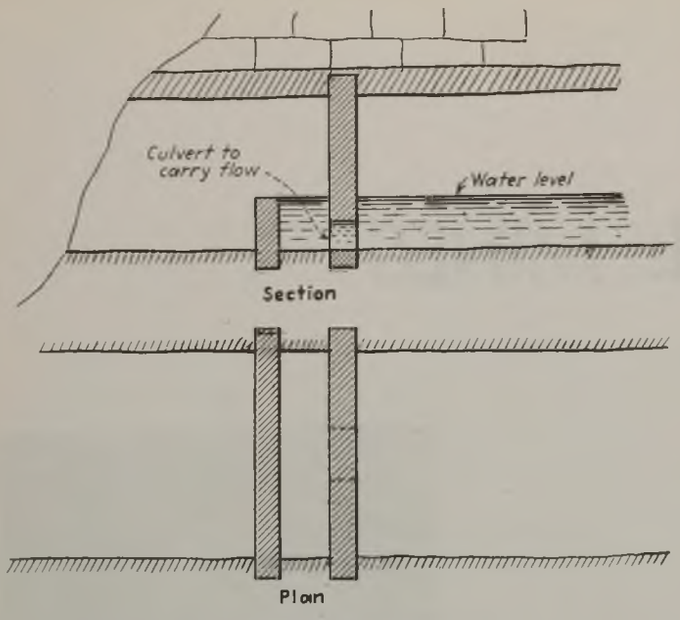
Coal-mine drainage usually is acid. This condition is caused by moist air coming in contact with pyrite in exposed coal-bearing strata and oxidizing the insoluble iron pyrites to water-soluble iron sulphates. These iron sulphates appear as white or greenish-white crystals on the coal ribs, mine floor or other places where iron pyrite is exposed to contact with air. Entering surface or subsurface waters dissolves the ferrous and ferric sulphate crystals so formed; further oxidation and chemical action known as hydrolysis liberate free sulphuric acid and iron oxide. The latter usually is a precipitate of yellow to red hydrated oxides of iron, which when it settles out, commonly is known as "sulphur mud." Precipitation and settling are accelerated by dilution of the mine drainage and quiescent conditions, and therefore usually occur to a large extent in stream beds outside the mine, where the characteristic red color has become familiar to many.

The free sulphuric acid liberated simultaneously with the iron oxides is colorless. It is the most active corrosive agent of coal-mine drainage. Moreover, the oxidation of pyrite to form iron sulphates, with subsequent hydrolysis to form iron oxide and free sulphuric acid, is continuous and the various steps usually are coexisting.

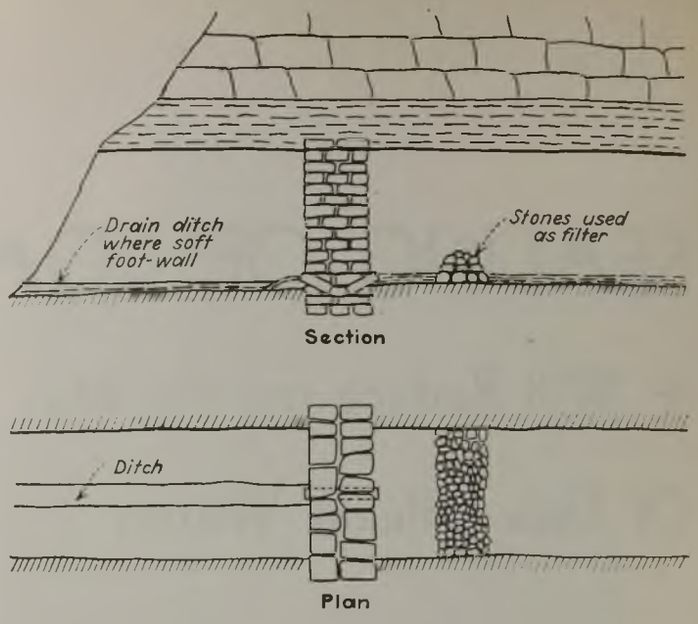
The idea of sealing abandoned mines or parts of active mines to exclude air and prevent acid formation, yet at the same time permit drainage to flow, occurred to the writer early in 1927. At that time he observed that drainage from a number of naturally caved mines was either not acid or was much less acid than that from open mines in the same district. The obvious reason for this condition appeared to be the absence of air in the caved mines. Laboratory experiments conducted soon afterward demonstrated that if oxygen could be kept from contact with iron pyrites, acid would not be formed. Since that time repeated practical illustrations of the theory have been observed and reported in the various references listed.

Early in the summer of 1933 it seemed likely that the public benefits to be realized from extensive sealing of abandoned mines would justify the necessary expenditure of public money made available for unemployment relief. Consequently, the Bureau of Mines advocated such use of relief funds. Damages done by acid drainage were cited, benefits to be expected from the sealing program were listed, and the general suitability of the project as a relief measure was described, with probable cost of the work. Sportsmen's organizations early realized the benefit of the work from a recreational standpoint, but failed to emphasize the economic value of reduced corrosion and the savings in treatment of public and industrial water supply.

In October, 1933, officials of the Penn-



Concrete Air Seal for Drift Mine.



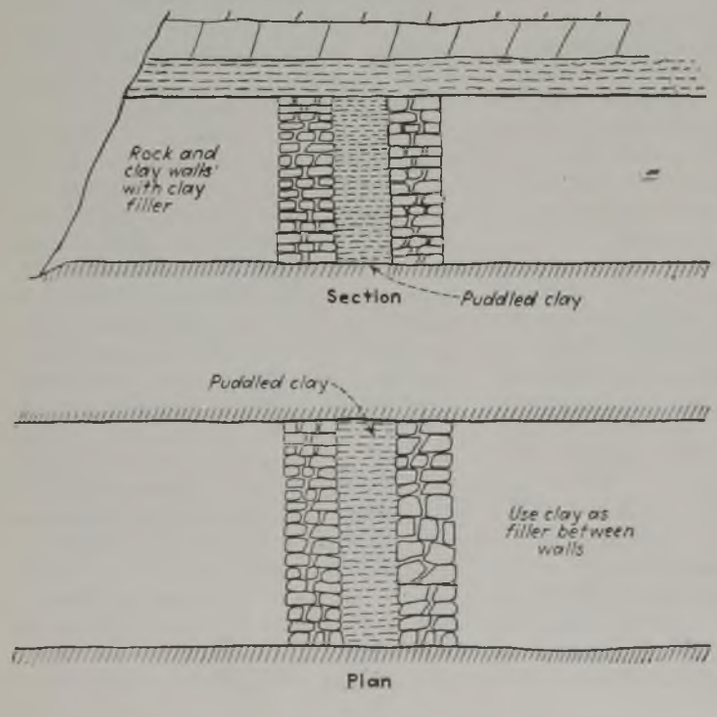
Rock Seal With Cement-Mortar Tile Drain.

sylvania Department of Health interested the U. S. Bureau of Public Health Service in the project, and that bureau obtained CWA funds because of the public-health aspects of the program. The work was begun early in December, 1933, as a federal CWA project, under the general direction of the U. S. Bureau of Public Health Service. The fund was divided among the several major coal-producing States upon estimates of the probable amount of work necessary in each. The actual direction of sealing abandoned mines in each State was assigned to the respective departments of health. Upon request the U. S. Bureau of Mines loaned the services of the writer to the U. S. Bureau of Public Health Service for approximately 2½ months to prepare directions for closing abandoned mines, advise in the selection of personnel, plan methods for the collection and analysis of samples, and assist in other related technical problems of less importance. A sum of $1,500,000 originally was allocated by the CWA for this program, but actually less than one-fifth of this amount was spent as a federal CWA project.

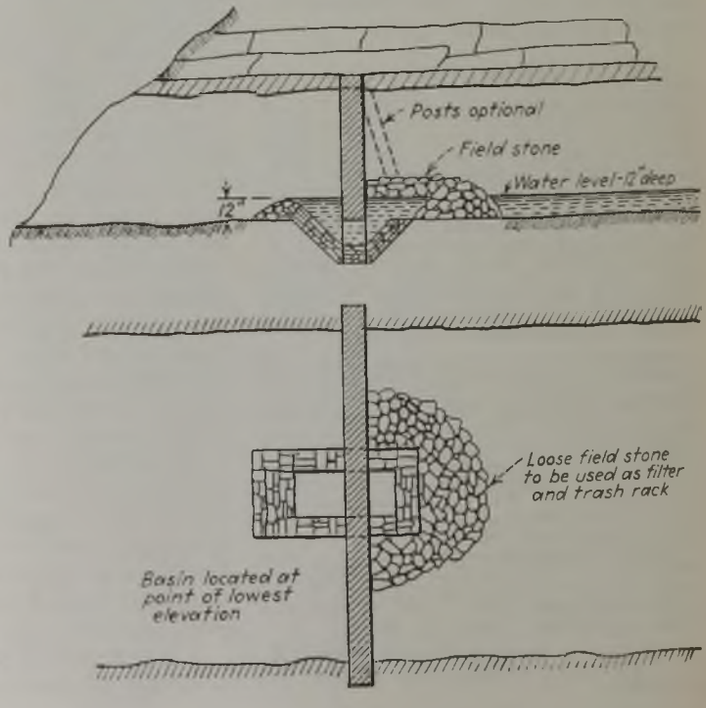
The States selected for allocation of money for mine-sealing work were: Pennsylvania, West Virginia, Alabama, Ohio, Kentucky, Maryland, Tennessee, Virginia, Illinois and Indiana. The allocation of money to the States was made by public health officials on the basis of probable work necessary in each State; these amounts ranged between approximately $20,000 and $600,000. The number of persons allowed for the work in each State ranged from about 300 to 2,600. Actually these quotas were never realized; the highest percentage is believed to have been employed in West Virginia, where for a short time nearly 75 per cent of its entire quota was at work.

Under federal CWA regulations the work was to last 2½ months, ending on Feb. 15, 1934. A few of the States began work soon after official notification of allocation of the money, while others were not able to start for several weeks. At best, the magnitude of the work and the time required for organizing it precluded any possibility of completion in 2½ months, and the general federal CWA "stop order" of Jan. 19, 1934, placed an additional handicap on continued progress. The necessity for

Rock Wall With Clay Mortar for Dry Openings



Air-Trap Seal With Field-Stone Dam to Exclude Dirt.



procuring releases on all properties—often from different owners of land and mineral rights—before sealing could be begun, the lack of tools and supplies, and finally the unusually severe winter weather of 1933-34 were all serious handicaps. Despite adverse conditions, sufficient work was done and interest aroused so that when the project passed out of federal control, West Virginia, Pennsylvania and Ohio carried on the work as State and finally as county projects in a limited manner for several months, at first as State CWA projects and later under provisions of the Federal Emergency Relief Administration.

In a paper[1] delivered before the convention of the American Water Works Association in September, 1934, E. S. Tisdale, director, Division of Sanitary Engineering, West Virginia Department of Health, enumerated the results of mine-sealing work in that State. He refers to a summary report formulated by the Ohio River Board of Engineers in which the following reasons for unified action in sealing abandoned mines are set forth:

"The report further enumerates in addition to the menace to public health . . . that acid mine drainage is damaging on account of:

"(*a*) Requiring increased cost of construction and operation of water works.

"(*b*) Corrosion of the metal and concrete of federally built and operated navigation dams, amounting to several million dollars annually, according to the reports of army engineers.

"(*c*) Corrosion of metal boats using such streams for transportation of goods in interstate commerce.

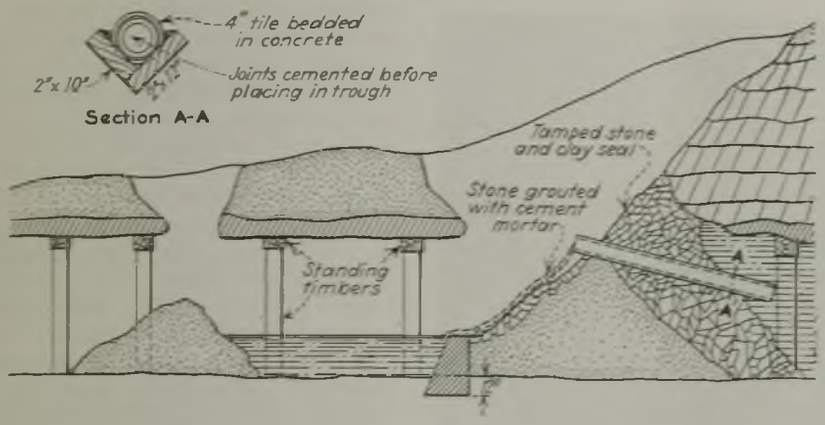
"(*d*) Making difficult the use of water of such streams for industrial and steam-raising purposes.

"(*e*) Disintegration of metal and concrete culverts and bridge abutments on State and federal highways as shown by studies in certain States.

"(*f*) Preventing stock watering in the smaller tributary streams and injury to agricultural lands.

"(*g*) Preventing recreational use of streams."

"The program," says Mr. Tisdale, "has been continuously carried on, though only about 150 men are at work in ten counties now (September, 1934), compared to nearly 1,000 in seventeen counties during the winter (1933-34) months." He states that it is estimated that one and one-third million pounds of acid are flowing from abandoned mines into West Virginia streams per day and that this weight slightly exceeds 36 per cent of the total from all mine drainage in the State. Idle mines add another 27 per cent of the total acid in all streams. Some or even most of these mines may never be operated again, so that the improvement possible in West Virginia is at once obvious. He states that "53 streams in northern West Virginia can be reclaimed, as the mines are 100 per cent abandoned and available for sealing." Up to Sept. 1, 1934, 205 mines have been sealed at a total cost of $155,000. The number of openings so closed was 4,025, and the average cost per opening has been about $38. Over 1,100 water tests have been made in order to measure accurately the rate of lessening acid content in the mine water. Approximately 3,500 openings still remain to be sealed, according to Mr. Tisdale's report.



Air-Trap Seal Set Back in Mine Where Roof Is Bad.

Two papers[3, 4] report very decided improvements. Some[4] of these follow:

"Public benefits derived from this project are threefold—that is, prevention of stream pollution, elimination of fire hazards and promotion of public safety. By stopping acid mine drainage, already from 100 to 200 miles of beautiful streams suffering from the ill effects of acid mine drainage have been benefited and are showing recovery to normal streams again. The Coal River . . . is the outstanding example to date. Major H. W. Shawhan, Director of Conservation, is authority for the statement concerning the improvement noted this year in Coal River. Watering stock, fishing and improved recreation facilities have been observed in several streams in Harrison, Marion and Barbour Counties. Carl Hornor, outstanding mining engineer in central West Virginia, in commenting upon the sealed mines on territory adjoining his properties, has stated that cattle are now drinking water issuing from sealed sections of these abandoned mines closed under our program . . .

"Contrary to expectations, the results of sealing have shown up much sooner than anticipated . . . even with many of the seals shrinking and admitting air, measurable and visible results are already apparent, showing acid reductions of 25 per cent and better.

"Exceptional cooperation and support have been received from both coal operators and surface owners. A substantial percentage of the material consisted of salvaged stone, lumber, brick, etc., donated by the coal companies and surface owners. . . . The program should be carried to completion in West Virginia. Economically, it is known that the *annual expense* caused by acid waters is many times the total cost of the preventive program."

On Oct. 4, 1934, B. F. Hatch, Sanitary Engineer, Department of Health, Columbus, Ohio, delivered a paper, entitled "Sealing Abandoned Coal Mines," before the Eighth Annual Ohio Conference on Sewage Treatment. This paper furnished additional information, some of which is quoted:

"There are no statutes in Ohio requiring mine owners to close openings when mines are abandoned. Owners of surface rights usually have insufficient funds to carry on the necessary construction. The land is often not worth the cost. Therefore, at the present time, the financial burden of any program of sealing abandoned mines must be borne either by the State or Federal Government." No survey for locating and listing abandoned mines in Ohio had been made previous to the sealing program. "Therefore, it may be fairly stated that in Ohio the mine-sealing program was started under the severe handicap of lack of basic information necessary to commence full-scale operations immediately.

"In closing drift openings it has been our practice to follow the methods of nature and resort to earth fills wherever possible. Naturally, this type of closure cannot be used on wet openings or along vertical outcrops. The earth fill, however, may be used in about nine openings in ten, and is the cheapest method of sealing. A complete closure of this type will cost on the average about $15. . . . In closing wet openings—that is, openings from which drainage is flowing—it is usually necessary to use masonry construction. Two general types are used . . . and local materials are used as far as possible. In many localities in the mining district stone from the roof or from adjacent outcrops may be obtained . . . Where such material is not available, the walls are constructed of brick or concrete. Stoppings of this type will cost from $30 to $250, depending upon the work required to clean out the openings, to ditch away accumulated drainage from behind cave-ins, and to retimber to provide safe working conditions.

"In slope and shaft mines our work centers largely in filling or capping shafts. . . . It is interesting to note that, although our present mining laws require that open shafts be protected by a fence, no provision is made for the maintenance of the fence. When the fence posts eventually rot off and the fence falls down, a yawning hole varying in depth from 15 to 250 ft. remains as a hazard to the safety of man and beast . . . On tillable farmland the owners prefer that the shafts be filled . . . in order to avoid having an obstruction in the field. In many such

[1] Tisdale, E. S., and Lyon, E. W.: "Scope and Accomplishments—Mine Sealing Program—Ohio River Watershed."

[4] Tisdale, E. S.; Lyon, E. W., and McNutt, J. P.: "The 'Why', 'How' and 'Where' of Abandoned Mine Sealing." State Health Department, Charleston, W. Va.

cases mine refuse from gob piles is used as filling material with a layer of earth on top." This is a sensible method of obtaining necessary filling, and it removes from the land surface, at least some unsightly refuse which, if not already burned, is a continual hazard to both air and stream pollution when left on the surface.

"On Oct. 1, 1934, we had closed 2,089 openings . . . About 75 per cent of these openings have been closed under FERA work projects set up since the close of CWA on April 1, 1934. . . . Under the FERA our maximum employment in all counties has never reached 200 men and has averaged about 130 men. . . . At the present time, between 400 and 500 openings are being closed per month. . . .

"During August and September, samples of the drainage from a number of mines which have been more or less completely sealed for several months were collected and analyzed. Comparison of these analyses with those of samples collected prior to sealing showed marked reduction in acidity in several instances. Taking into consideration the fact that the volume of drainage was found to be less than the previous measurements, the results prove the soundness of the basic theory on which the program is based.

" . . . While the mine-sealing program was inaugurated primarily to rehabilitate surface streams already polluted by mine drainage as a protection to public water supplies, several other advantages have been self-evident as the work has progressed. Enumerated in the order of their relative importance, these are as follows:

"1. Recovery of smaller streams for stock watering.

"2. Protection to property from mine fires started in abandoned openings by trespassers or by adjacent brush fires.

"3. Reclamation of bottom lands formerly rendered unfit for grazing or agricultural purposes by acid drainage.

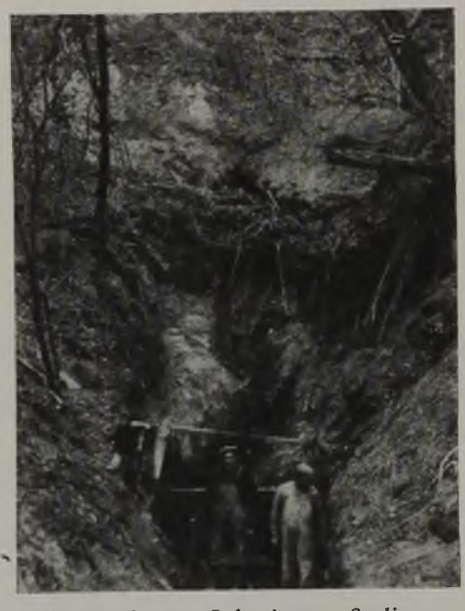
"4. Protecting public safety by removal of hazards such as unprotected shafts, drift, and slope openings.

"5. Recovery of streams for recreational purposes.

" . . . The program has progressed sufficiently far to warrant the conclusion that the sealing of abandoned mine openings to exclude air from contact with acid-forming materials in the mine workings will materially reduce and perhaps ultimately correct the acid mine-drainage problem from abandoned mines. It is recommended that legislation be immediately enacted in Ohio requiring that mine openings be closed when abandoned by the mining companies involved. . . ."

No authoritative information is available from Pennsylvania later than April 28, 1934. In a report[6] covering work done up to that time, J. W. Paul states that 32 mines had been completely sealed. Work has been continued as county relief projects more or less steadily for more than a year under the general direction of the Sanitary Water Board, Pennsylvania Department of Health. According to a paper[6] prepared for the Coal Division of the A.I.M.E. in October, 1934, a few sealed mines in Pennsylvania have discharged greatly reduced quantities of acid drainage since sealing. At the same time, acidity values were reduced markedly. Forty-two selected openings in West Virginia, Ohio and Pennsylvania were said to be discharging about 21 tons less acid per day at that time than before the mines were sealed. Newspaper reports from time to time cite improved stream conditions in several localities credited to sealing abandoned mines.

In Butler County, Pennsylvania, a group of sixteen workmen under the direction of L. G. Hines and Francis Patterson, working independently of the



Preparations as Laborious as Sealing.

State program, closed sixteen mines on Slippery Rock Creek watershed early in 1934 in accordance with the advice of the writer and following Bureau of Mines procedure. Greatly decreased acidities in the water from several of these openings already have been noted, and four swimming beaches previously unfit for use are stated to have been improved so that they can now be used. Labor was furnished through CWA and RWD authorities of Butler County, and the necessary tools and supplies were furnished by the workmen or bought from funds of sportsmen's organizations of New Castle, Elwood City and Slippery Rock. The average cost to close the 32 openings in these mines, in 21 of which water traps were constructed, was $56. The average cost for traps was $86. The cost of the traps was kept low by using materials available at or near the sites. A total of 3,100 man-hours was required and the work was very well done. The residents of that section are highly elated at the definite improvement already noted.

The procedure of excluding air to reduce formation of acid can be applied in active mines where the room-and-pillar system of mining is used. It has been shown (U. S. Bureau of Mines Report of Investigations 2994) that acid water "made" in sealed sections of active mines becomes alkaline in a relatively short time after sealing. This finding is supported further by Mr. Harris[7] in practical experience in southern Indiana coal fields. In 1928 Mr. Harris said[7] that sealing worked-out sections of active mines "will be the means of saving the coal industry many hundreds of thousands of dollars annually." Corrosion of pipes and pumps incidental to handling acid mine drainage is often a very expensive item in operation of mines. As work proceeds, sections finished could be sealed if water originates there. The alkaline effluent resulting in a short time not only will remove the previous acid burden from those sections but will have a definite neutralizing value when mixed with acid waters from active sections that cannot be so treated. The acidity of the main discharge will be reduced to that extent. It is not unreasonable to predict that this sealing procedure would result in an alkaline effluent for the whole mine long before completion of mining operations. The probable reduction in corrosion that might be noted by mine operators is obvious.

It seems quite conclusive that sealing abandoned mines will remove a considerable pollution burden from natural streams. Many streams in coal-producing States are polluted only by wastes from abandoned mines. The advantages of transforming these damaging wastes to beneficial alkaline waters seem evident from reports already available from a few of the States where sealing has been applied. Most responsible officials in direct contact with the work report wholehearted cooperation, particularly from mine operators. Those who have studied the question from an economic standpoint have uniformly admitted that chemical neutralization is generally impracticable and that sealing abandoned mines to exclude air and yet permit drainage to continue to flow is the first practicable method yet suggested for decreased stream pollution by acid mine waters.

So far as the mining industry is concerned, general application of the idea to worked-out sections of operating mines can effect a great saving in operating costs, and the improvements that can result from sealing abandoned mines will remove a great deal of the general criticism directed at the industry as an outstanding contributor to stream pollution. The nature and magnitude of this work suggest the necessity for federal or State funds. However, the enormous cost of present water treatment and the direct or indirect troubles experienced by so many persons indicate that if it is impossible to obtain public money for this work it could be supported profitably by other organizations.

[5]Paul, J. W., Assistant Director: "Sealing Abandoned Coal Mines in Pennsylvania," May, 1934.

[6]Paul, J. W.: Trans. A.I.M.E., 1934.

[7]Private communication to the U. S. Bureau of Mines.

BATTERY OR CABLE-REEL?

+ What Do Two Types of Locomotive Haulage Show Under Similar Operating Conditions?

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STORAGE-BATTERY LOCOMOTIVES are not only much safer than the cable-reel type with explosion-tested parts but, under many conditions, performance in cars gathered per day can equal that of the cable-reel equipment. Steep grades and long distances from sidetracks, however, are handicaps in storage-battery transportation; moreover, the cost is approximately one cent per ton greater than with cable-reel locomotives. These conclusions are drawn from comparative tests and study of the two types of equipment under similar conditions at the Keystone No. 1 mine of the Houston Collieries Co., McDowell County, West Virginia. The comparisons set forth in this article and in those which will follow, it should be emphasized, are based upon the specific conditions existing at the Keystone mine and would not apply at all mines.

Keystone mine is a drift opening in the Pocahontas No. 3 seam, where the coal averages 66 in. in thickness and has a 4-in. parting. The mine is operated on an advance-robbing system. No drawslate is taken. Rooms are driven 400 ft. up grades averaging 2 per cent. The distance between room-pillar lines is 60 ft., rooms are 18 ft. wide, pillars between rooms are 42 ft., and the grades of panel entries average about level. In a typical working section, the number of working places in pillars equals the number of rooms being driven.

The cable-reeel locomotives weigh 8½ tons and have explosion-tested electrical parts; the permissable storage-battery locomotives each weigh 9.2 tons with batteries. Direct-current voltage is 550. Empty cars weigh 2 tons and carry an average load of 4 tons. Average room haul for both room and pillar work is 200 ft. Since the locomotives make two trips into each room and working place for each car of coal, the average room travel of the locomotive and empty cars is 800 ft. per loaded car. One of the last sidetracks built provides three tracks—one for loads, one for empties and the third as a passing track. Neither the intermediate nor gathering locomotive can block the other locomotive with loads or empties. In other sections of the mine, sidetrack facilities are not so well adapted for making high records in gathering-locomotive performance.

Closer supervision and more maintenance are required to keep cable-reel locomotives in their original condition than for battery locomotives. Inclosed electrical parts on the former type require more attention than the equipment of lower voltage on battery locomotives, where arcs are almost negligible as compared with those on 500-volt and 250-volt equipment. Nitric acid is formed by the latter arcs and causes deterioration of many of the parts, resulting in higher maintenance costs and more delays.

Trailing cables have been known to be completely destroyed both while on reels and while lying on the track. This hazard has been eliminated, however, by the use of fuses in fused trolley taps (fuse nips). To make the use of large fuses which would not blow promptly in case of cable trouble unnecessary, the following preventives have been used: overload protection applied to the locomotive which will open ahead of the nip fuse; series operation on trailing cable; mines projected to secure grades favorable to the loads; special nipping cable; and maintaining high voltage. Overload protection on the locomotives is the instantaneous type and is adjusted to open on overloads before the fuse of the trolley tap blows. Relays were adjusted to open at 74 amp. series and 174 amp. parallel. Tests are made by rapidly opening the controller while the trailing cable is connected to the trolley wire through its fused trolley tap. If the fuse blows on this test the overload setting is reduced.

With this arrangement, trouble on the locomotive is cleared without causing the motorman the inconvenience of replacing the fuse in the trolley tap, hence no incentive exists for applying a larger fuse or bridging the fuse. Sixty-ampere fuses with time delay thermal lag plates have been found ample for 500-volt circuits. On shorts, these fuses blow as fast as standard fuses (Table I).

Nips fused to 125 amp. were found large enough to carry all loads on trailing cables at a 250-volt mine with reel locomotives having sealed equipment. This is equivalent to 62.5-amp. fuses for a 500-volt mine. These 250-volt locomotives were equipped with instantaneous-acting relays having separate cables for the cable and trolley-pole circuits. The fuses blew only when there

Table I—Time Required for Blowing 60-Amp. Thermal Lag Fuses, and Comparison With Locomotive Load Characteristics

Overload Per Cent	Amperes	Duration Seconds
10	66	(continuous, fuse did not blow)
50	90	105
100	120	41
150	210	21
	Normal Loads on Locomotive:	
	Amperes	Duration Seconds
	33	78
	39	18
	72	1

Table II—Cable Data and Reel Capacities

	Cable Conductor Sizes				
	2	3	4	6	8
Reel capacity, 2-conductor concentric—feet	456	480	544	680	1,032
Volts drop in above lengths of 2-conductor cable at 50 amp	7.26	9.55	13.77	27.4	66
Reel capacity, single-conductor—feet	880	978	1,216	1,644	....
Continuous capacity—amperes	90	80	70	50	35
Additional capacity per inch of reel height, 2-conductor—feet	57	60	68	85	129
Additional capacity per inch of reel height, single-conductor—feet	110	122	152	203	....

was trouble on the trailing cables.

In order to determine the action of fuses when cables are damaged, short-circuit tests were made on trailing cables, with 125-amp. fuses in the nips. The test point was 12,600 ft. from the substation on a circuit consisting of one 4/0 trolley wire and 60-lb. track, without positive feeder. The cable was No. 4 concentric double-conductor with outside insulation of rubber. A locomotive was run over the cable repeatedly until it was shorted. Arcs were almost negligible, but the wheel moved 2 or 3 in. before the arc was extinguished. The locomotive speed was about 2 miles per hour, therefore the arc lasted about 0.09 second. Under average conditions in the mine, due to lower resistance of the circuit, there would be greater currents in the shorts, with a corresponding decrease in the time required for the fuse link to melt and rupture the arc. The travel of the locomotive wheel and the length of the arc would therefore be less under average conditions than was the case in the test.

Similar tests were made with the ground clamp at the nip end of the cable removed from the rail, thereby getting short-circuit arcs at the rail between the cable and the rail only, as would happen with a single-conductor cable. The fuse nip did not blow every time a short occurred. The locomotive sometimes pushed the cable away from the rail after the short was formed, thereby causing a longer and wilder arc.

The tests indicate that when proper size fuse nips are used, arcs due to shorts on double-conductor cables are almost negligible. The arcs are of sufficient magnitude, no doubt, to ignite an explosive mixture of methane and air, but such an explosive mixture would seldom exist under the locomotive.

If the use of nips is not to be supervised or if fuse nips are not used, single-conductor cable would be safer than double-conductor cable. Two single-conductor cables would be safer than one single-conductor, as the second conductor would carry the return current and eliminate arcing at rail joints. These joint arcs are very severe and dangerous at times. Two single-conductor cables with a fuse nip, however, are not considered as safe as a double-conductor cable. With a short in the latter cable, current great enough to invariably blow the fuse in the nip is the desired condition. The negative conductor of a double-conductor cable always is close to the positive conductor when a short occurs and stays close as long as the arc exists. There would not always be an equivalent low-resistance return path with either one or two single-conductor cables.

One locomotive is gathering mine cars in a typical section with two attachments of the fuse nip and rail clamp, and seven rooms are served with one attachment point. The loads are left on the panel entry until the trailing cable is detached from the trolley wire. The trip is then assembled with the trolley pole in use.

It would be necessary, however, to keep the trolley wire opposite all room necks and as close to the pillar line as at present. In the majority of the sections all loads for one turn could be assembled with power from the trailing cable and this should not overload the cable or fuse nip. The distance between the end of the trolley wire and the pillar line is limited by three factors: length of trailing cable on locomotives and mining machines, waiting for pillar line to advance sufficiently to remove trolley wire in reasonable lengths, and neglect to remove trolley wire as often as possible.

All working places in the majority of room entries can be reached with a 500-ft. No. 4 cable with the trolley wire 450 ft. from the pillar lines. At several locations, however, the trolley wires are much closer to the pillar lines. Normal currents on trailing cables of cable-reel locomotives in the Keystone mine could be carried with No. 8 cable, but it would be necessary to use this cable carefully in order to avoid pulling it to pieces. No. 6 cable has sufficient mechanical strength and ample current-carrying capacity.

Ammeter charts for one day's operation showed maximum peak currents of 45, 54 and 60 amp. and the average currents were much less. By utilizing the full capacity of the cable reels, No. 6 cable would reach 135 ft. farther and No. 8 cable 488 ft. farther than the present cable. If the distance from the pillar line to the trolley wire were increased beyond the reach of the present mining machine cable it would then be desirable to provide an insulated machine wire beyond the trolley wire.

In order to further aid in keeping the trolley wire the maximum possible distance from the pillar line it should be possible in the majority of the sections to haul loaded trips part of the way to the sidetracks with the trailing cable. In order to avoid overloading the trailing cable, one-half of the loads for one turn could be hauled to the sidetrack at one time. Provision should be made for the locomotive to run around the loads on the sidetrack with-

Table III—Performance Data of Cable-Reel and Battery Locomotives in Keystone Mine

	Cable-Reel Type							Battery Type			
	Local Serial Numbers							Local Serial Numbers			
Section of Mine	16 8 Cross 1st King	17 7 Cross 2nd King	18 10 Cross 1st King	25 7 Cross 1st King	26 14 Cross 1st King	28 9 Cross 1st King	Averages	21 8-9-10 Cross 2nd King	22 13 Cross 1st King	23 6 Cross 2nd King	Averages
Distance traveled with trips to and from sidetrack, miles	3.032	.095	.344	.928	.878	3.940			1.137	1.515	
Distance room neck to side track, min. ft	1,000	50	130	350	290	1,300	520	1,150	250	400	600
Distance room neck to side track, max. ft	1,560	600	770	450[1] 820 920[1]	1,360	1,525	1,106	1,525	670	770	988
Distance room neck to side track, ave. ft	1,280	325	450	635	825	1,412	821	1,211	460	585	756
Loaded cars, coal and slate, per shift	59	53	56	63	49	48	55	56	72	58	62
Empty cars, coal and slate, per shift	59	53	56	63	49	48	55	56	72	58	62
Ampere-hours per shift								577	525	410	
Ampere-hours per loaded car								10.2	7.2	7.0	
Kilowatt-hours per shift								49.3	44.9	35.1	
Kilowatt-hours per loaded car								.88	.62	.60	.70
Average grade on entry, against loads	level	level	level	leve	leve	level		+2%	level	level	
Average grade in working places—per cent (— against loads, + with)	—2	—2	—2	—2	—2	—2		level & + 2	—2	—2	
Number of working places	8	11	8	9	6	6	8	8	6	6	6.6
Number of loaders	20	22	20	18	18	14	18.6	18	18	20	18.6
Cars per trip	8	11	8	9	6	6	7.6	8[2]	6	6	6.6
Trips per shift	8	5	7	7	8	8	7.0	6[2]	12	10	9.3
Tons coal per shift	236	212	224	252	196	192	219	216	288	232	245
Tons coal per loader		9.6	11.2			13.7	11.7	12	16	11.6	13.1
Time required to serve all places one time—minutes			35.12					62.0			
Time required to gather all cars—minutes			251.12					372.0			
Idle time per shift—minutes			229.00					108.0			
Time on trailing cable—minutes			190.75								
Time on nip—minutes			49.87								
Time on trolley pole—minutes			10.50								

[1]To empty side track.
[2]Six single car trips in addition.

out waiting for the intermediate or main-haulage locomotive to move the loads from the sidetrack. That arrangement always is desirable in order to expedite gathering operations. The capacity of 600-volt all-rubber-insulation cable that can be accommodated on the present reels is given in Table II. These reels are 42 in. in diameter and have an 8-in. space between flanges.

Since series operation on trailing cables reduces the current about 50 per cent, the nip fuse can be proportionally smaller. This reduces by considerably more than 50 per cent the time required for the fuse to blow. The short-circuit arcs are therefore of very short duration and of little magnitude. Fuses of 60-amp. rating have been used and the arcs are much smaller than the ones described for the short-circuit tests with 125-amp. fuses. The locomotive control was arranged so that parallel operation on the trailing cable could not be performed. Parallel operation on trailing cable would increase locomotive speeds about 140 per cent, but that would cause either more derailments or operation on resistance, both of which are objectionable.

Arcs at unbonded rail joints in rooms are due to two primary causes: return current from locomotives or mining machines using single-conductor cable, or current that has entered the room from the panel entry and crossed from one room rail to the other through trucks of mine cars, locomotives or mining machines. The latter cannot happen if the room track is cross-bonded at the room neck and adequate bonding is maintained on panel entries, nor if insulated rail joints are installed at room necks.

Special Nipping Cable Provided

In adjoining mines in lower coal it was found impossible to turn the trolley pole whenever desired. A special nipping cable with automatic transfer switch was provided for this condition. The object desired was to keep the heavy entry work off the trailing cable and the fuse nip, thus eliminating the necessity for larger fuses, which would not blow on short-circuits.

Driving rooms upgrade held down the current loads on trailing cables and fuse nips. The heaviest loads on the cable are due to pushing one empty mine car up into the rooms. Adequate d.c. voltage in the mine reduces the duration of all locomotive loads and, therefore, aids in using small fuse nips. The current is practically the same with high or low voltage for a given size trip, but the heating effect on the fuse link is less with the higher voltage, due to the locomotive being in motion a shorter time for any movement. This statement is predicated on the assumption that the locomotive has speed characteristics slow enough to prevent running on resistance points.

Table IV—Ampere-Hour Test on Battery Locomotive, Comparing Two Methods of Gathering

	Total	Per Car	Percentage
Nine-car trip assembled as gathered	65	7.22	100
Nine-car trip assembled after gathered	60	6.66	92.2
Nine-car trip assembled as gathered	70	7.78	100
Nine-car trip assembled after gathered	65	7.72	93
Average two above trips assembled as gathered	67.5	7.50	100
Average two above trips assembled after gathered	62.5	6.94	92.7
Average saving by assembling after gathered	5.0	.56	7.3

Table V—Shift Time-Study of Cable-Reel Locomotive Performance

	Time Per Cent
In mine	100
Idle	49.6
Working	50.4
On Trailing cable	35.4
On nip	9.2
On trolley pole (including 20 minutes travel from and to motor barn)	5.7

Time studies indicate that numerous delays limit the daily tonnages of both the cable-reel and battery locomotives. Neither type is limited at present by operating characteristics, power, or battery capacity. Time required for using cable terminal rail clamps and fuse nips on trailing cables of reel-type locomotives is negligible. Table III shows the distance to sidetracks, grades in rooms and entries, and locomotive performance.

Battery locomotives are limited by battery capacity in the total work that can be performed, and cannot be universally applied to all mining conditions. Steep grades against the loads and long distances to sidetracks seriously restrict their gathering capacity. It has been found economical to have battery locomotives designed for very low speeds. The original battery installation of 54 cells 570-amp.-hr. capacity was changed to 45 cells 720-amp.-hr. capacity. The required ampere-hours per car remained the same with a reduction of 16.7 per cent in kilowatt-hours per car. The battery locomotives are equipped with two motors each rated at 15 hp. at 100 volts. Battery voltages at the end of the shift (1.75 volts per cell) are as follows: 54-cell, 94.5 volts; 45-cell, 78.8 volts.

The larger battery has 26 per cent additional ampere-hour capacity and the same additional capacity in cars hauled per day, although the additional kilowatt-hour capacity is but 5 per cent. These figures are based on six-hour discharge rates and do not give the larger cells credit for an increase in ampere-hours, kilowatt-hours and voltage due to discharging at a lower amperage per unit area of plates.

The 800-ft. travel of the locomotive and empty car for each load could be materially reduced by changing cars in crosscuts in the rooms. This would reduce the daily mileage of both types of locomotives and increase their capacity and also permit using a battery at least 30 per cent smaller than the present one. The reduction in room travel for the locomotive would be 27 per cent and for the empty car 63 per cent. If crosscuts were used for switching, the additional investment and depreciation charges on three switches in each room would be more than offset by the advantage of increasing the daily production of each gathering locomotive only one car per day, not counting the reduction in required battery size and battery charges. Both types of locomotives have a large proportion of idle time which could be eliminated.

It was found by test that a saving of 7.3 per cent in ampere-hours per car could be made by letting loads stand at room necks after they are pulled out of the rooms and then assembling the loaded trip at one time. The other method is to use a progressive trip assembly system. By this method a locomotive places an empty at the room face and then comes out of the room and moves inby on the panel entry and couples to the loaded cars that have been gathered from previous rooms and moves the loaded cars outby to the next room, exchanging an empty for a loaded car in this room.

One Operation Gives Saving

By assembling the loaded trip at one operation a saving in acceleration losses is made. The locomotive moves continuously until all cars are bumped up together. The energy stored in the locomotive and in the first loaded car is partly dissipated in the succeeding loaded cars and is not wasted in brake applications. Test readings on four successive trips are given in Table IV. The use of a "bump-up" system of assembling the loaded cars would permit a saving in battery cost if the battery size were reduced in proportion to the saving in power consumption, or as an alternative more cars per shift could be gathered with the same size battery. This might mean an increase of six or seven cars per day. The "bump-up" system, of course, would not be practicable for all conditions of grades and clearances.

The speed characteristics of the two types of locomotives at Keystone mine are quite different. Referring to speed only, the battery locomotives should gather more cars per day than the cable-reel locomotives because the former are about 40 per cent faster for room and light switching work than the reel locomotives. The majority of the distance traveled is at light loads. The cable-reel locomotives are approximately 65 per cent faster than the battery locomotives for hauling trips to and from sidetracks (assuming the voltage in the section is reasonably high). Results of a time-study of a cable-reel locomotive are given in Table V.

800,000,000 GAL. OF WATER

+ Removed From an Overlying Bed

In Southern Anthracite Coal Mine

By T. M. DODSON
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A SERIES of diamond drillholes, driven from two mines in the Southern Anthracite Region at varying angles from the horizontal and with suitable protection against flooding, tapped 800,000,000 gal. of water and made possible the safe extraction of 2,500,000 tons of coal. One of these holes failed to reach its mark and had to be torn open at its far end by dynamite; another became bent in its course, as was shown by a survey of the hole, and when exploded failed to open up a passage for water and had to be abandoned. Water from one of the holes contained bacteria which exploded when relieved from the water pressure, emitted a sulphurous gas which made the eyes of trackmen and others sore.

The properties, which are now known as Oak Hill and Pine Hill, were first opened for operation in 1832, at which time mining was confined largely to the Diamond bed. The workings were operated from two main entrances, Potts' and Starr's slopes, and the thickness of the bed ranged between 7 and 8 ft. and pitched between 35 and 38 deg. The workings extended west from Potts' slope a distance of about 4,000 ft. to the property in which Lytle colliery is now operating and to the east about the same distance from the beginning of what is known as Starr's slope workings. They extended down the pitch to a depth of 900 ft. (see Fig. 1).

In 1868, all operations in the Diamond bed were abandoned and allowed to fill with water because, as appears from the old records, the pumps then available could not handle the water. From then

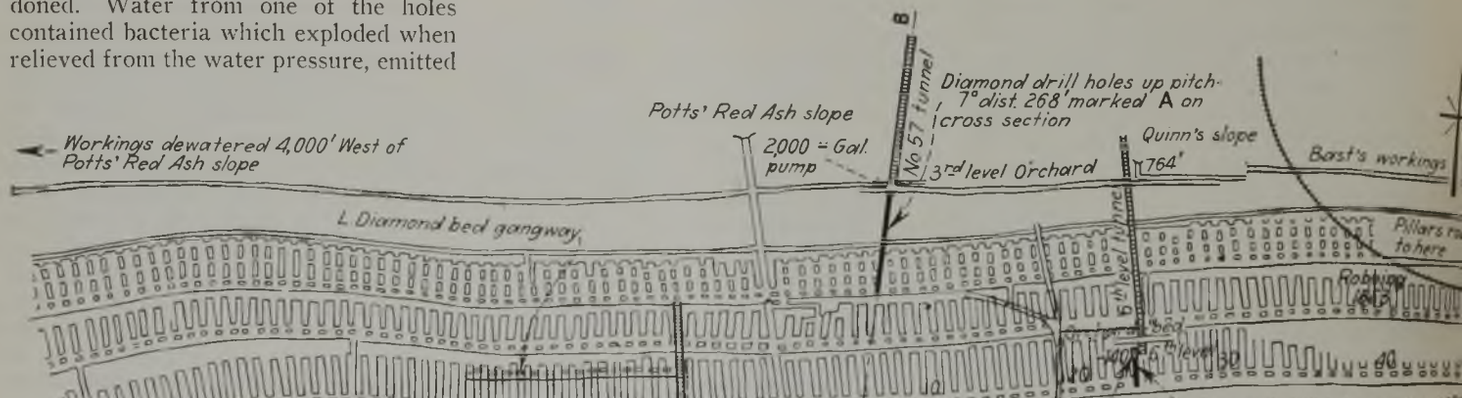


Fig. 1—Workings in Abandoned Potts' Red Ash Slope

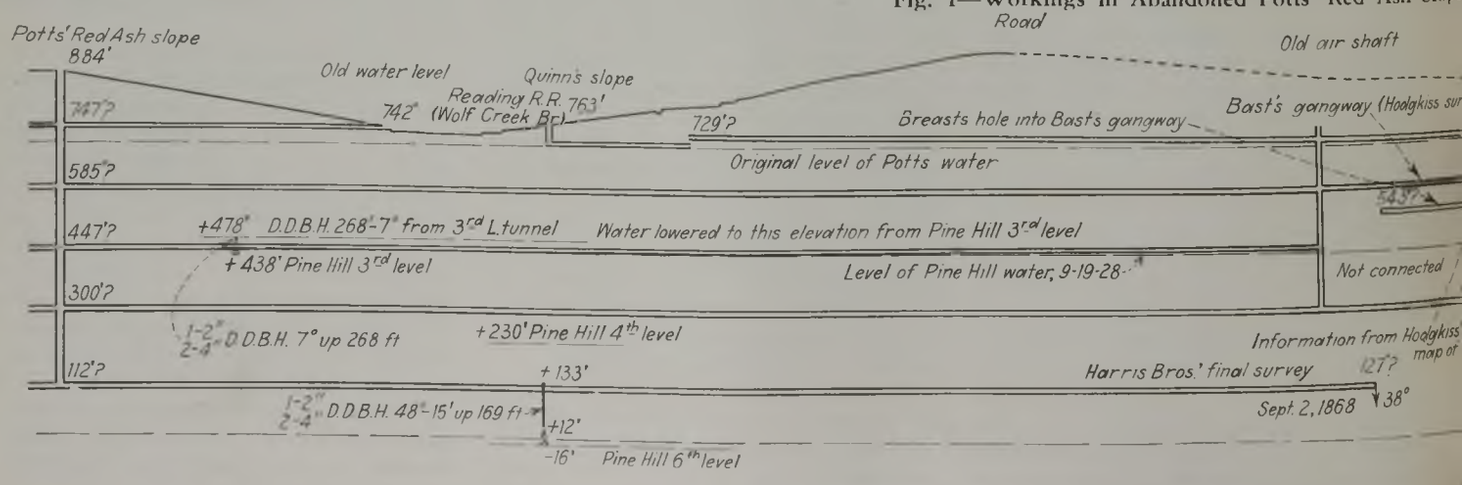


Fig. 2—Projected Longitudinal Section Showing Diamond Bed Wor...

on until 1927, mining, because of the presence of overlying water, was necessarily confined to the underlying beds in the area lying roughly to the north of the vertical line shown in Fig. 3. This limitation made it impossible to mine immediately 1,500,000 tons in the overlying beds above the sixth level or even to make feasible the future recovery of 1,000,000 tons which was lying in these beds below the sixth level.

For this reason an engineering study was made as to the feasibility of either working these beds from a slope in the Little Diamond bed or of dewatering the Diamond bed, which project would involve the removal of approximately 800,000,000 gal. of water. The projected driving of the slope was abandoned because of its initial cost and continuous high operation and transportation expense, as well as for the reason that the presence of water in the Diamond bed would make the working of the Orchard bed and the robbing of the Primrose bed extremely hazardous.

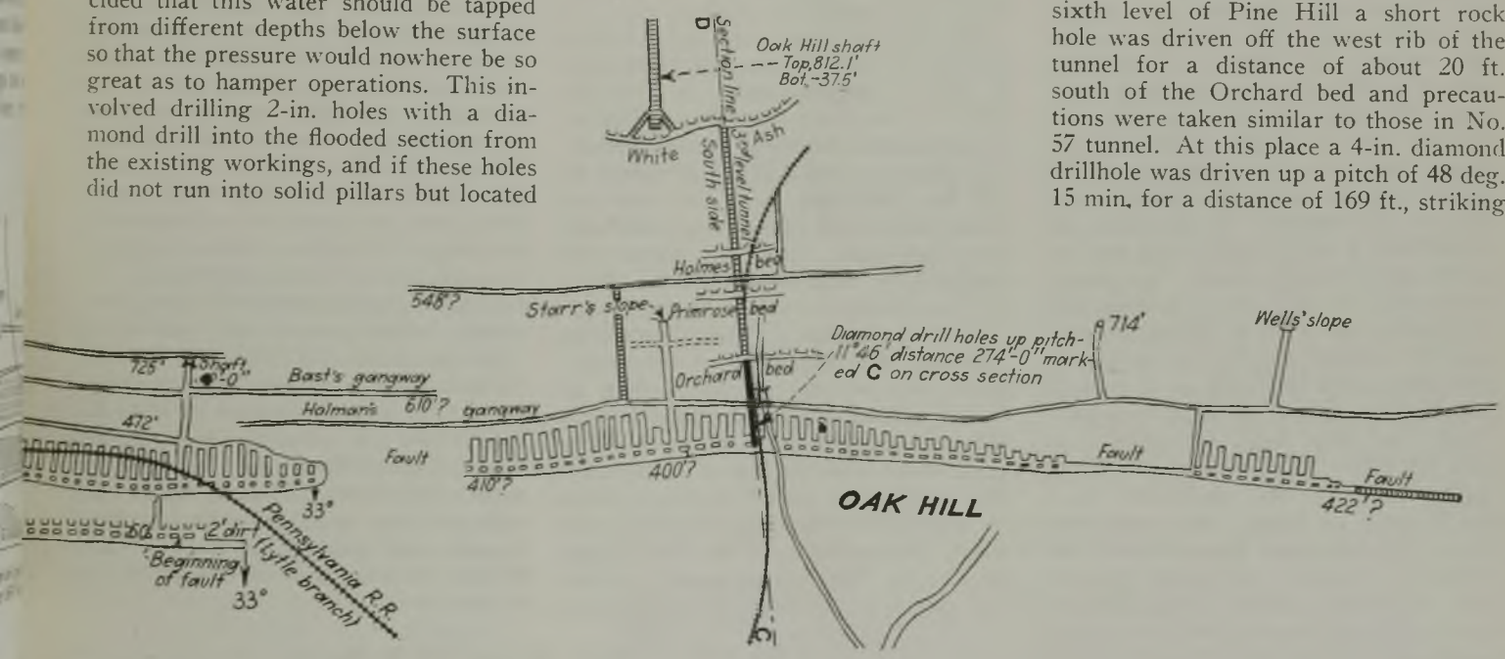
With the above factors in mind, it became obvious that if this coal was to be recovered, it could be done only by dewatering the Diamond bed. It was decided that this water should be tapped from different depths below the surface so that the pressure would nowhere be so great as to hamper operations. This involved drilling 2-in. holes with a diamond drill into the flooded section from the existing workings, and if these holes did not run into solid pillars but located water, 4-in. holes would be drilled alongside them to furnish the needed capacity. Special equipment was necessary so that drilling could proceed readily and the water be controlled when tapped. For the latter purpose sets of double valves were designed and built with a stuffing box between the two valves. Furthermore, special standards and braces were built to hold the drilling machines and valves in place.

With these arrangements completed, the first 2-in. hole was started at the face of No. 57 tunnel on the third level of Pine Hill (see Fig. 3). This hole was driven a distance of 268 ft. up a 7-deg. pitch, and on Aug. 7, 1927, the first water was struck. Everything worked as planned; the water was under control from the minute it was found. Two 4-in. holes were driven alongside the 2-in. hole, and on Sept. 7 one of the 4-in. holes struck water. The pressure on the end of the drill hole was 116 lb., which indicated a head of 267 ft., checking out closely with the calculated head (see Fig. 2).

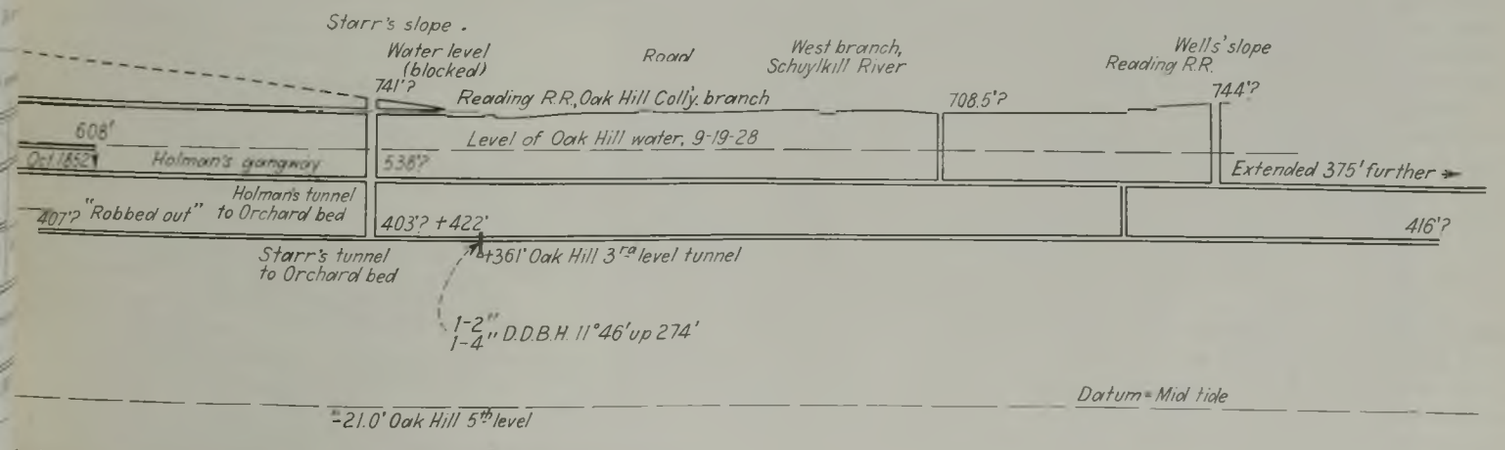
On Sept. 10, a 2,000-g.p.m. pump was installed at the boreholes in the West Orchard gangway (see Fig. 1) and the 2-in. hole and two 4-in. holes were connected by a manifold and in turn connected to the suction end of the pump. With the assistance of the water head in the old workings, the pump for some time had a capacity of over 3,500 g.p.m. Pumping continued until Oct. 1, when the pressure had been reduced to 15 lb. At this time pumping was stopped and not resumed until Dec. 19, when the pressure had again reached 75 lb. Water was then drawn off from the borehole until Feb. 4, 1928, at which time the pressure had been reduced to 10 lb., or a head of 23 ft.

While the Pine Hill third level Orchard gangway was being pumped, diamond drillholes were being driven on the Pine Hill sixth level at the end of No. 2 tunnel (see Fig. 3) and on the third level at Oak Hill at the face of the South Side Tunnel (see Fig. 4). The hole at Oak Hill was drilled because the lower workings in the top properties had not been connected; hence the water above the Oak Hill mine in these lower workings could not be drained off through the Pine Hill drillholes.

At the face of No. 2 tunnel on the sixth level of Pine Hill a short rock hole was driven off the west rib of the tunnel for a distance of about 20 ft. south of the Orchard bed and precautions were taken similar to those in No. 57 tunnel. At this place a 4-in. diamond drillhole was driven up a pitch of 48 deg. 15 min. for a distance of 169 ft., striking



s Slope Dewatered by Drilling From Lower Measures



lation to Tapping Water at Pine Hill and Oak Hill Collieries

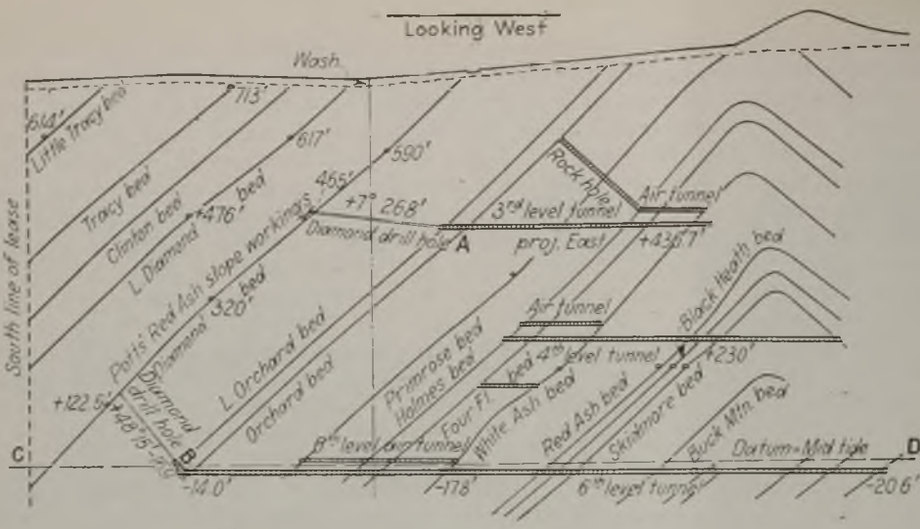


Fig. 3—Cross-Section on Line C-D in Fig. 1.

the Diamond bed, but only a small quantity of water was obtained.

Much discussion arose as to the advisability of detonating a charge of dynamite at the end of the hole, for fear that it might cause a fire or explode gas, but it was decided that in the presence of water it would be safe to do so; therefore a 6-ft. length of tube pointed at one end like a rocket was made and charged with 60-per-cent dynamite. A special cable of No. 14 wire, heavily covered with rubber and built for conducting current at 600 volts, was attached to the tube. The cable was thus heavily covered so that the leads could not rub against the rock and short-circuit the charge when it was being pushed to the face of the borehole. In the back end of this tube a split wooden plug was inserted and a wooden wedge was placed in the split, so that, when the tube had reached the end of the borehole, pressure could be exerted against the wedge, to split and spread the plug so as to hold the charge in place when it exploded.

The shot was fired successfully on Sept. 15, 1928. A pressure of 200 lb. per square inch, or the equivalent of a 460-ft. head of water, was registered. From that time until May 13, 1929, the valves were opened and closed periodically, the water drained being added to that in the sixth level, which was being handled by the pumping station of that level. At that date the pressure had been reduced to 60 lb., which was equivalent to the elevation of the top of the borehole in the Diamond bed, showing that those workings had been drained.

During this work, a 2-in. diamond drillhole was driven into the Diamond bed from the top slate of the Orchard vein in the Oak Hill third level South Side tunnel (see Fig. 4). This drillhole was driven up the pitch at an angle of 8 deg. 32 min. and had been extended for a distance of 293 ft. when it struck the Diamond bed, where it went through coal for a distance of 10 ft. 6 in. and then through 5 ft. 9 in. of slate. No water was in evidence, suggesting that the hole had entered a solid pillar. However, when the hole was surveyed with a test tube partially filled with hydrofluoric acid, it was evident that the hole had curved down below the old gangway of the flooded area toward which it originally had been directed. This hole was then opened by dynamiting, as in the sixth level of Pine Hill; however, the burden evidently was too great and the explosion resulted only in so plugging the hole with wire, wood, etc., that a new hole had to be drilled.

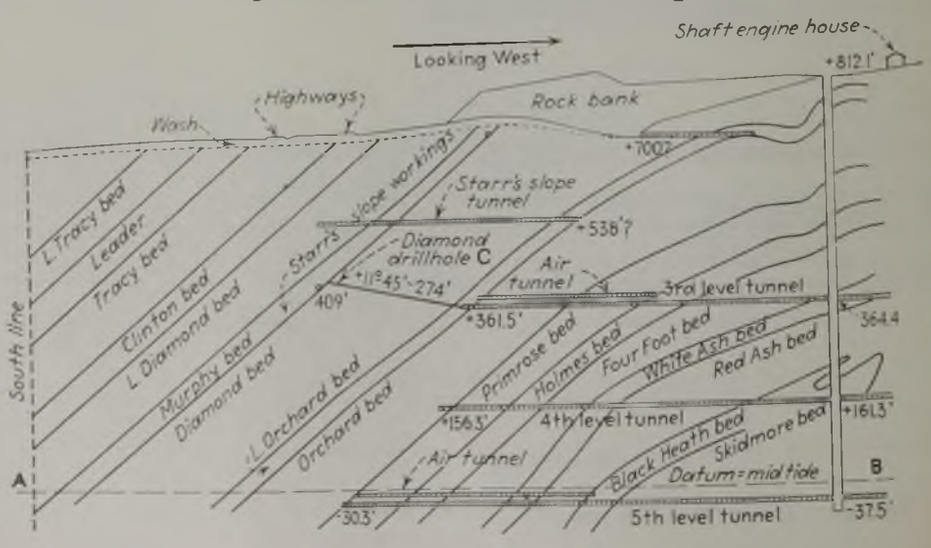
The new 2-in. hole was advanced on a pitch of 10 deg. 54 min. for a distance of 287 ft., striking water on July 20, 1928. A 4-in. hole was then drilled in the immediate vicinity of this hole, striking water on Sept. 15. A pressure of 120 lb., indicating a 277-ft. head of water, was found. The valves were left open continually, and the water was conveyed by troughs through the third-level watercourse to the pumping station, whence it was raised to the surface.

During this dewatering it was ascertained that an old passage known as Starr's tunnel connected the Diamond bed with the Orchard (see Fig. 4). Not being sure as to the extent of any possible working in the Orchard bed above the third level which might be filled with water, the management decided to drill up into it. This was done with a 2-in. hole from a point in the third level South Side tunnel, about 60 ft. south of the Primrose gangway. No water was obtained, but 4 ft. 8 in. of good coal was found in the bed.

During the early dewatering of the Oak Hill side, a dark deposit was noticed forming on the bottom of the ditch, and, though nothing alarming developed immediately, the nature of this deposit was much discussed. After the dewatering had been progressing for some time, several men who were laying track, timbering, etc., in that section came to the emergency hospital with sore eyes and were found to be suffering from a disease known as "pink eye," so they were sent to the doctor for treatment. Other men put to work in this vicinity almost immediately developed the same ailment. As far as ventilation and other conditions were concerned, the area was entirely normal, but the idea persisted that the dark deposit in the ditch had caused the eye irritation, so samples of the water from this overlying bed were sent to the laboratory of the Warne Hospital in Pottsville for culture, which revealed that the bacteria were not "gas formers" as commonly classified. Nevertheless, the bacteriologists were of the opinion that the gas came from these microorganisms, for the faint sulphurous odor emanating from this water indicated that they exploded as soon as the presence of the water was relieved, releasing the gas, which in turn affected the eyes of the workmen. To rectify this condition, the water was piped direct from the mouth of the borehole to the pump. This done, the eye ailments disappeared immediately and did not occur again. Incidentally, this piping connection reduced power costs materially.

By the summer of 1929 eight diamond drillholes had been driven from underground for a total distance of 1,944 ft., 800,000,000 gal. of water had been removed, 2,500,000 tons of coal had been made recoverable without a serious accident of any sort, or in fact without anyone even getting his feet wet, and without the loss of a single working day at the mine.

Fig. 4—Cross-Section on Line A-B in Fig. 1.



GATHERING LOAD

+ Carried by Battery Locomotives

At Jackson Hill Mines

STORAGE-BATTERY locomotives have been carrying the gathering load at the Jackson Hill No. 7 mine of the Jackson Hill Coal & Coke Co., Shelburn, Ind., since their adoption in 1921, one year after the mine was opened, and for several years prior to the adoption of the seven-hour day six units were placing an average of 1,600 tons of coal per day on the partings. With the shorter day, tonnage dropped to an average of 1,500 and an extra motor has been placed in service recently to increase output slightly above the preceding level. In gathering this tonnage, these units regularly operate over grades running up to 11 to 13 per cent.

Rapid changes in both the magnitude and direction of grades are a characteristic of that particular area of the "Glendora," or "Lost Vein," seam mined at Jackson Hill No. 7, a shaft operation. Thickness of the seam, which occupies approximately the same position as the Indiana Fifth Vein but is substantially different in character, averages 5 ft. 8 in. It generally is overlaid by the gray, chalky slate of the Glendora seam, which in places, however, thins out, leaving the black slate normally accompanying the Fifth Vein. As in other operations in the Glendora seam, careful and systematic timbering of entries is a necessity.

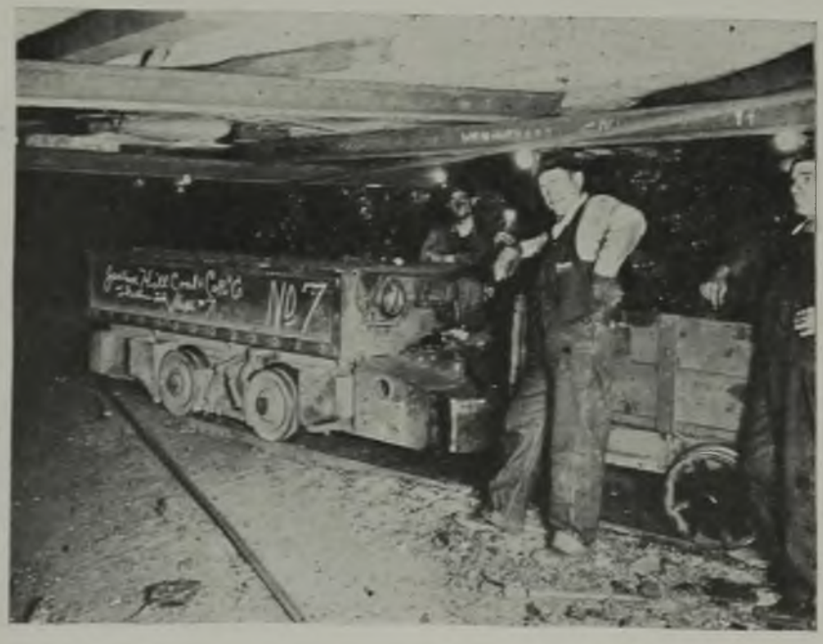
While the panel system of operation, involving the turning of rooms both ways from the panel entries, is standard at No. 7, the irregular occurrence of hills frequently makes modifications of the basic plan necessary. These modifications take the form of changes in the direction of main, cross and panel entries; length of panel entries, and consequently the number of rooms; as well as room depth. The standard room panel, however, consists of 60 rooms, or 30 on each side of the entry. Normal room depth is 200 ft. Room centers and width are respectively 36 ft. and 24 ft., and each place is supplied with a single track of 20-lb. rails on steel ties carried in the center of the place. The miners are divided into groups of two each, each group working two adjacent rooms. This arrangement facilitates car distribution by the gathering locomotives, which generally serve 24 to 26 men each and take trips of 12 to 15 empties from the partings, distributing one car to every other place on the way up the panel. To conserve batteries and give the locomotives more time for other work, the empties, grades permitting, are trammed to the face by the miners. Otherwise, they are pushed in by the locomotive.

When the locomotive has distributed the last of its trip of empties, it starts gathering the loads at the top of the panel heading, completing the trip at the mouth of the heading and pulling it to the parting. Loaded cars are handled exclusively by the locomotives, which pull them from the face.

To reduce the distance traveled by the gathering units and thereby increase their effectiveness, the general plan of development calls for the establishment of partings between every other pair of panel entries, as indicated in Fig. 1. One such parting therefore serves four panel entries or eight groups of rooms, and under this system the maximum distance from the parting to the face of the farthest room seldom is over 1,500 ft. and usually is less than 1,200 ft.

Adoption of battery gathering locomotives at Jackson Hill No. 7 mine, and also at the No. 6 mine in the No. 5 seam at West Clinton, Ind., was based primarily on the possibilities of economies through reduction in bonding and trolley wire and elimination of that portion of the demand peak which normally would be encountered in operation of the gathering equipment off the trolley system. Other factors weighed in the choice of the battery type of equipment were the relatively low speed as compared with the general standard in those days, ability to start heavy loads when necessary, quick acceleration and smooth operation growing out of independence of the effect of fluctuations in voltage, elimination of cable troubles and expense, and reduction in armature and coil failures growing out of the

Battery Unit at Jackson Hill No. 7. Thomas W. Faulds, General Superintendent, Appears Right, and Next to Him, William Moore, Superintendent.



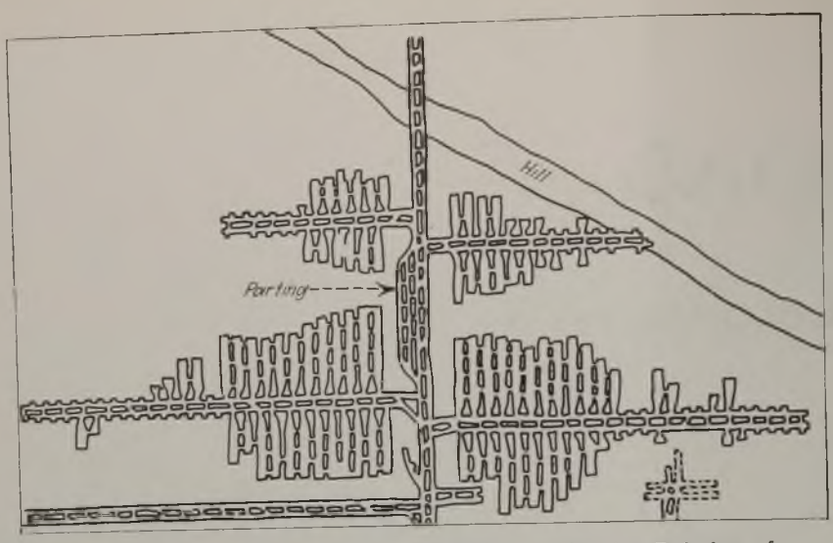


Fig. 1—Development at Jackson Hill No. 7, Showing Relation of Partings to Working Places

fact that the current flowing to the motor is limited by the capacity of the battery.

Equipment at No. 7 mine, part of which is held in reserve, consists of six Whitcomb and two Ironton locomotives, all single-motor units with worm-gear drives. With the exception of one 6-ton Whitcomb unit, all the locomotives are rated at 5 tons. Battery equipment is as follows: two Exide-Hycap 48-cell 33-plate units; one 42-cell 33-plate Exide-Hycap unit; and five 48-cell 29-plate Exide-Ironclad units, all furnished by the Electric Storage Battery Co.

Recognizing that efficient battery-locomotive operation requires maximum utilization of the energy in the battery in useful work, the Jackson Hill management early set up two major objectives: (1) elimination of as much excess haul and excess trip resistance as possible and (2) maintenance of the battery and locomotive in condition to supply when required and utilize efficiently, respectively, the available energy in the battery. The relatively short rooms, hand tramming of empties and location of partings close to the working sections noted above were the major steps taken to reduce distance traveled.

To reduce resistance to movement of trips, the wooden cars adopted were equipped with anti-friction bearings of the loose-roller and Hyatt types. As loaded by the miners, the No. 7 cars average 5,000 lb. of coal. Car weight is approximately 2,000 lb. Regular inspection and adequate lubrication are relied upon to keep bearings working efficiently.

In the field of maintenance of batteries, effort at Jackson Hill has been directed to reducing work at the mine to the simplest essentials necessary for reliable operation. Battery charging and inspection are placed in the hands of a night charger, who also lubricates the units, makes minor repairs and adjustments in controllers and other locomotive parts, cleans up batteries and locomotives—an essential point in the company's program—and performs such other tasks as may merit his attention. Daily reports showing battery condition, nature of the charge and condition of auxiliary equipment are made out by the night charger. These reports show ampere-hours out of the battery at the end of the working shift, as registered by the ampere-hour meter on the locomotive; temperature of the battery and specific gravity of the electrolyte; ampere-hours of charge put in the battery and temperature and specific gravity at the end of the charging period; hours over which the various charging rates were maintained; and water, control, brake, brake shoe and sand condition. Space also is provided for reporting on other items than those listed, or for explanatory remarks, if necessary.

Both 80- and 90-volt locomotive motors are used at No. 7, and batteries are charged two at a time in series off the 250-volt d.c. circuit through a resistance panel. This panel is designed to permit charging in a maximum of three steps—80-90, 40 and 20 amp. Normally, after a full shift of service, charging involves all three steps, the length of time each current value continues being limited, in the absence of other factors, by the temperature rise in the battery. Occasionally, depending upon the state of discharge or the temperature when charging begins, the first step is omitted. Once each week, each battery is given a 15 per cent equalizing charge.

Every two or three months, batteries are checked cell by cell by the manufacturer's field service man, who submits a complete report of his findings and recommendations for the guidance of operating officials, including Thomas W. Faulds, general superintendent; William Moore, superintendent, No. 7 mine; and William Holler, superintendent, No. 6 mine. In addition, general supervision over battery-locomotive operation is exercised by Prof. C. C. Knipmeyer, Rose Polytechnic Institute, consulting engineer to the company.

Cutting Down the 13-Per-Cent Grade on the Hill Shown in Fig. 1

Service Life Increases

With care in maintenance and operation and improvement in battery construction, effective life at No. 7 mine has been increased substantially in late years. In earlier years, while batteries were kept in service an average of five years, four years was the average over which battery performance could be maintained at normal over the entire shaft. The last Exide-Ironclad units, on the other hand, have been in service five years with no appreciable decrease in their ability to operate at normal rating throughout the shift. Days operated per year have averaged 180 over the life of the mine. One of the two Ironton locomotives, equipped with a 48-cell 29-plate Exide-Ironclad battery, was regularly operating over grades ranging from 8 to 11 per cent on three hills in 1 and 2 South panels off 16th East entry and hauling an average of 120 cars in seven hours without appreciable battery weakness at the end of the shift at the time this article was prepared.

At Jackson Hill No. 6—a pick operation—equipment now in service in gathering an average of 400 cars averaging 4,500 tons of coal each is made up of five 4-ton Whitcomb chain-drive locomotives, two equipped with Exide-Hycap and three with Exide-Ironclad batteries. The No. 5 seam operated at this mine averages 4½ ft. in thickness and the grades are comparatively light, varying from 1 to 3 per cent as a rule. Mine-car design, parting arrangement and battery charging, maintenance and operation are similar to those at No. 7. At No. 6, however, one man is assigned to a place, and car-changing methods have been modified to allow placing of empties and pulling of loads alternately on opposite sides of room entries.

WHAT FAN TESTS SHOW

+ In Mine Ventilation

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A MINE FAN should be given credit not only for the static pressure it produces in overcoming the mine resistance but also for the head necessary to generate the velocity called "velocity pressure." The sum of the two is called "total pressure." Some, however, still question whether a mine fan should be given credit for static pressure only or for the total pressure produced. In most tests of exhaust mine fans the total pressure is obtained, but those who make them believe they have obtained static pressure only. Any tube inserted in the fan drift of an exhaust fan will register the total pressure even though the opening at the end of the tube may not face the current or the tube be set lengthwise of the duct.

Much care should be exercised in testing a blowing fan. A tube inserted between fan and mine will usually register the static pressure only. It is necessary to have a pipe connection, and the end of the pipe must face the current. If a fan is installed at an air shaft it should have credit for the work done in turning the air into the shaft, and in this case the pipe should be placed between fan and air shaft and should face the air current.

Natural Ventilation a Factor

Another important item to consider in testing a mine fan is natural ventilation. In iron mines, much reliance is placed on this factor and it plays an important rôle in many copper mines, as well as in the pitching seams of the anthracite region. No degree of accuracy in fan tests can be obtained if the natural ventilation is with the fan, but if it is working against the natural ventilation, more accurate figures are obtainable. Therefore, a fan preferably should be tested in the summer, when the temperature on the outside is higher than in the mine. The only exception is where with an exhaust fan the intake is at a considerably higher elevation than the fan, for in that case the natural ventilation is with the fan and the actual pressure which the fan produces will not be registered.

In testing a mine fan during the colder months, the natural ventilation usually is with the fan whether exhaust or blowing, and the actual pressure is not obtainable. The exception in this case is again where with an exhaust fan the intake is at a higher elevation than the fan, in consequence of which the natural ventilation would oppose its operation. It has been found in some cases that a fan working normally or against natural ventilation in the summer produced a 2-in. gage, but during the cold months only 1-in., with the speed and volume remaining practically unchanged. It must be reasonably assumed that the mechanical efficiency of the fan would have been much higher if the gage showed 2-in. rather than 1-in.

Ventilation Here With Fan

The apparent low efficiency when the fan was tested at 1-in. gage may be explained by taking a practical problem. Assume two air shafts each 545 ft. deep with the fan used as an exhaust and the temperature approximately 70 deg. in the upcast shaft and approximately 10 deg. above zero in the downcast shaft. The pressure exerted by a motive column 545 ft. high on one square foot of area with the temperature at 10 deg. is 46.05 lb., while the pressure exerted on the same area and same height but with a temperature of 70 deg. is 40.85 lb. The difference is 5.2 lb., which is equal to 1-in. water gage. The natural ventilation, of course, is with the fan and equal to 1-in. pressure.

Mine pressure at the foot of the downcast shaft is equal to the atmospheric pressure at the top of this shaft plus the weight of the column of air in the shaft. The pressure at the bottom of the upcast shaft is equal to the atmospheric pressure at the top of this shaft plus the weight of the column of air in the shaft, which, in this example, is 5.2 lb. less than in the downcast shaft. The volume passed due to this differential pressure is equal to that passed with a fan operating at 1-in. gage without natural ventilation. It is now necessary to operate the fan a certain number of revolutions to pass this volume of air before a perceptible gage is registered at the fan. Even when the gage does register, the fan is greatly overloaded, and the effective pressure produced by the fan will be low as compared to its speed. It is now evident that as the fan must handle all the volume produced by natural ventilation, and does not get credit for all the work it is doing, the mechanical efficiency will be quite low.

To demonstrate further the effects of natural ventilation on fan performance consider another case. Let it be assumed that a mine will pass 100,000 cu.ft. per minute at 2-in. water gage without the influence of natural ventilation. Suppose the fan, when operating at 200 r.p.m., has a normal capacity equal to that of the mine, or 100,000 cu.ft. at 2-in. gage The fan is a blowing unit and is installed at an elevation 450 ft. below the outlet of the mine. On the day of test the temperature is 32 deg. outside and 70 deg. inside the mine. The weight of a cubic foot of air at 32 deg. is 0.080728 lb. and at 70 deg. is 0.07495 lb. The difference between the weight of mine air and outside air multiplied by the difference in elevation—namely, 450 ft.—gives 2.6 lb., or 0.5-in. water gage.

Bratticing Inlet and Outlet

If the intake were bratticed off so that no air passed, a water gage mounted on this brattice would measure 0.5-in. negative pressure. On the other hand, if the outlet were bratticed off and a gage mounted on the brattice it would show 0.5-in. positive pressure. If this brattice were removed, a volume of 50,000 cu.ft. per minute would pass and the pressure at the intake and outlet would drop down to that due to velocity alone.

A differential pressure of 0.5 in. will generate a velocity of approximately 2,800 ft. per minute, depending on the density of the air. Assume that the mine had an airway measuring 60 sq.ft.,

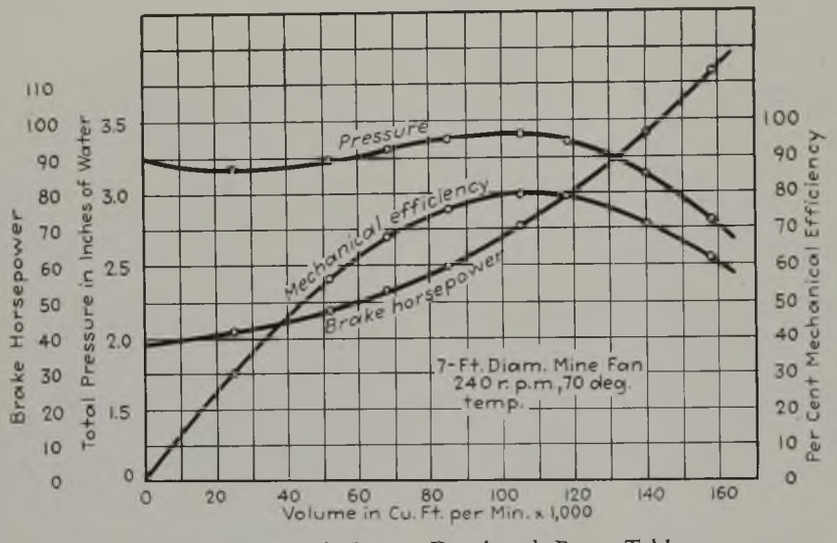
then a volume of 168,000 cu.ft. per minute would flow were it not for the resistance due to the rubbing surface, turns in the airway, and the sudden expansion and contraction of the airway. In our problem this resistance has decreased the volume from 168,000 to 50,000 cu.ft. per minute, which shows that mine resistance plays a most important part in the ventilation of a mine.

It is understood in this case that the air bypassed the fan. Now suppose the air is passed through it. It is evident that the fan will add much resistance to the 0.5 in. offered by the mine, so say the volume is cut down to 40,000 cu.ft. The fan is now compelled to handle the latter volume without even being started. Just as soon as the wheel starts rotating, a pressure is produced by the blades which augments the flow of air through the mine. The pressure in the mine is below the atmospheric pressure at the fan. Consequently a force fan must be operated at a certain number of revolutions before a positive pressure is registered. Even then, because of the greatly overloaded condition of the fan at the lower speeds, the manometric yield or effective positive pressure produced will be comparatively low.

Under these conditions the results obtained when the fan has attained full speed will depend altogether on the fan characteristics. The fan must overcome a differential negative pressure of 0.5 in., though it is given credit on the gage for the measured or positive pressure only. The volume will be in excess of normal rated capacity, but the measured gage will be below rated pressure.

Natural ventilation acts as a penalty to mechanical efficiency if the fan is credited with only the measured pressure. It does, however, help to get a larger volume of air through the mine when the current is with the fan. If the current is against the fan, it offers a greater resistance and consequently decreases the volume, but the gage will register the true pressure produced by the fan at all times.

No fan should be tested for its mechanical efficiency when there is a differential pressure between the fan and mine unless this differential is against the fan. Quite a number of fans are installed at air shafts where the downcast and upcast are of the same depth and elevation. If the shafts are 450 ft. deep and the temperature outside is 32 deg. and in the upcast 70 deg., then 0.5 in. of differential pressure exists. Either a blowing or exhaust fan installed at these shafts will have the natural ventilation pressure with it in the winter. In the summer, when the temperature outside is hotter than in the mine, then the natural flow of the air will be against the fans.



Constant Speed Curves Developed From Table

The object in testing a mine fan is to ascertain definitely if the efficiency meets the guarantee of the manufacturer, and to determine its characteristics over a wide range of duties. But this last is seldom done. In fact, it usually is impractical to make extensive tests of an installed fan. The coal operator generally is content to operate the fan at some certain speed, and if the volume and horsepower specified in the contract are found approximately correct, he is usually satisfied. In order to make a complete mine-fan test, an elaborate set-up is required. Provisions must be made not only to handle the volume of air as specified in the contract, against a certain resistance at some definite speed, but also to ascertain the fan's characteristics operating under varying conditions.

There should be a definite understanding between the purchaser and manufacturer both as to the efficiencies assumed for motor and drive and as to the method of taking the volume readings and pressure—that is, whether that method is such as to give total or static pressure. The characteristic curve on the motor usually is assumed correct. A fair average of a motor efficiency with full load is 90 per cent. On small motors 87 per cent may be used, while large motors will develop around 93 per cent. If the motor is greatly underloaded, the efficiency will be very much less than these figures.

In measuring the power consumption of an alternating-current motor, the use of an ammeter will give reasonable accuracy if the motor is operating at approximately full load and the voltage is the same as that at which the motor is rated. Then the power factor can be taken from the characteristics of the motor and used in computing the power input.

If the motor is operating at substantially less than full load, however, a slight error in the ammeter reading will result in taking from the characteristic curves a value for the power factor which will be several per cent off the true value, and the power consumption calculated on this basis will be in error to the same extent that the power factor is in error. The reason for this is that at light load the variation of current with load is slight, while the variation of power factor with load is great. Hence an error of, say, 1 per cent in measuring the current will result in an error of several per cent in the power factor as taken from the characteristic curves.

Also the power factor varies with the voltage with which the motor is operating. If the voltage is other than the rated voltage of the motor, which is the voltage for which the characteristic curves are drawn, then the value of power factor taken from the characteristic curves will not be right, and the power consumption calculated from such a value will be in error.

Should Use Wattmeter on Motor

The only method of measuring power consumption for an alternating-current motor on which reliance can be placed regardless of load and voltage is by the use of a wattmeter. Efficiency at the power input measured is taken from the characteristic curves, and thus the power at the motor shaft determined. Of course, the efficiency for a given power consumption varies to a certain extent with the voltage, but if the voltage does not differ greatly from the rated voltage, the efficiency taken from the characteristic curves will be sufficiently accurate for practical purposes.

Another contribution to accuracy is the choosing of the correct efficiency figure for the drive. Needless to say, the drive selected initially should be in keeping with the duty to be performed. It should be specified with ample capacity in order that it may be operated without undue tension. Tight belts are mechanically inefficient. On the other hand, it is important not to go to the extreme in belt capacity. A good drive, working near its normal capacity, will

have an efficiency of about 95 per cent. Yet if the same drive at the same belt speed is loaded to only 20 per cent of its capacity, it is doubtful if the efficiency will exceed 85 per cent.

When tested in the field, mine fans are often charged with total input to motor, whereas they should be charged only with the actual horsepower delivered to the fan shaft—not with the total input to motor and drive. Consider an installation where a 100-hp. motor with a drive of the same capacity is used for an actual brake horsepower requirement on the shaft of less than 10. It is heard that this fan has an extremely low efficiency. An analysis of the installation would show that at least 8 hp. is lost in the operation of the motor itself; another 5 hp. is lost in the belt, making a total consumption of 13 hp. before any mechanical power is applied to the fan shaft. Assume the fan had an actual mechanical efficiency of 75 per cent. If this fan is charged with motor and belt losses as above, its efficiency will be indicated as being only about 33 per cent. It is unfortunate that these mistakes should be made, but experience has shown they are not infrequent.

In view of the foregoing it will be seen that generally only approximate results are obtained in tests of a mine fan in the field. Laboratory tests are more accurate. Every facility is available in a laboratory to obtain correct measurements, and there is no natural ventilation to affect the movement of air.

Tests Establish Characteristics

The following test of a 7x3½-ft. double-inlet, stepped multi-bladed, primarily exhaust, reversible mine fan is submitted to illustrate the various steps necessary to ascertain the fan's characteristics over a wide range of duties. The test was made at the factory with the fan exhausting, and an elaborate set-up was provided. The intake and outlet for the air were on the same level, of course, and the temperature in the duct, 70 deg., was the same as that of the air which the fan handled. This made an ideal condition for a test.

For this test a duct 100 ft. long, 12 ft. wide and 6 ft. high was constructed. The end of the duct was fitted with a rectangular pyramid by which the volume passing through the duct was regulated. The duct was divided into 72 sections, and the velocity measured in each section. The total velocity measured divided by the time elapsed in minutes gave the average velocity in feet per minute.

Four water gages were used, one on each side of the fan just back of the fan inlets, which were practically free of air velocity, and one on each side of the duct, close to the fan but shielded from the air current. All readings on the water gages checked each other closely, indicating equal pressure on each side of the fan, consequently equal volume.

Velocity readings were taken by two experienced men, one using a 4-in. Tycos and the other a 4-in. Davis anemometer. Their readings were in close agreement, but the average registered velocity was used after calibrations were made. Pitot-tube readings also were taken as a check, and in general these readings were a little higher than those recorded by anemometer after the calibrations were made. This serves to bear out the contention that calibrations of anemometers generally add nothing to accuracy, a point which will be discussed later in this article.

The motor was a 100-hp., 870-r.p.m., 3-phase, 60-cycle, 440-volt, squirrel-cage unit fitted with a pulley of 18 in. diameter and 15-in. face. The belt was of double-ply leather, 14 in. wide and operated at a belt speed of 4,100 ft. per minute on approximately 22-ft. centers. The fan was fitted with a 66-in. diameter pulley, and the duties in the tabulation were adjusted to a fan speed of 240 r.p.m.

Does Fall Increase Gage?

The object in analyzing this test is to point out certain fundamental principles relative to the operation of a mine fan. One often hears arguments whether a fan running at a constant speed requires more power or less where the airways are choked than where there is no obstruction. In the operation of a fan with forward-curved blades at a constant speed, does a large fall in the airway materially increase the pressure (water gage)? How is a curve plotted to show the true characteristics of a mine fan when operating at a constant speed but under varying conditions? Answers to the above will be pointed out in analyzing the test—see table.

The first test was run with the orifice of passage completely closed; consequently, no air passed through the fan. This set-up compares with a mine with airway entirely blocked. The gage registered 3.26 in., the input to the motor was 42.2 kw. and the brake horsepower applied to the fan shaft was 38.5. The fan efficiency, volume ratio and air horsepower were zero because no air was passing.

Test No. 2 was run with the orifice of passage slightly open and corresponds to that of a mine in which the airways are very badly restricted. The gage registered 3.175 in., which is slightly lower than on the first test. The input to the motor was a shade less, but it will be noted that the brake horsepower applied to fan shaft is 41.8, an increase of 3.3 over Test No. 1. The fan efficiency is 29.9 per cent and the volume ratio is only 79.5 per cent, both of which indicate the fan as being entirely too large for the regulated volume.

Test No. 3 showed a volume of 52,000 cu.ft. with a gage of 3.225 in. and 45.5 kw. input to the motor. The brake horsepower on the fan shaft was 47.2, an increase of 5.4 over Test No. 2. The fan efficiency was 56 per cent and the volume ratio 165 per cent. It is to be noted that while the water gage remains about the same, yet as the volume increases, the fan efficiency increases as well as the horsepower applied to fan shaft.

In Tests Nos. 4, 5 and 6 the same progressive increases are seen in the kilowatt input to the motor, horsepower applied to the fan shaft, fan efficiency and volume ratio of the fan. The gage has increased to 3.4 in. and the manometric ratio after reaching its low point on the second test has climbed to 99.4 per cent.

In Tests Nos. 7, 8 and 9 there is a progressive decline in pressure produced, fan efficiency and manometric ratio, proving that the most efficient capacity of the fan is about 110,000 cu.ft. at around 3.4-in. water gage when operating at 240 r.p.m. In Test No. 9, delivering 158,000 cu.ft., the fan is greatly overloaded, the effective pressure has dropped to 2.81 in. and the fan efficiency to 62 per cent from a high of almost 80 per cent.

Three Conclusions From Test

Certain lessons can be learned from a careful study of the tabulations of this fan test:

First and most important, the fan can work over a wide range of duties and still maintain a high efficiency.

Second, the water gage does not increase with a clogged airway, but, on the other hand, does slightly increase when the airways are opened to the normal rated capacity of the fan—referring specifically to the stepped multi-bladed type.

Test of 7x3½ Ft. Centrifugal Fan

Test No.	Air Volume Cu.Ft./ Min.	Air Velocity Ft./Min.	Gage In. of Water	Motor Input Kw.	Motor Efficiency Per Cent	Belt Efficiency Per Cent	Brake Horse Power	Air Horse Power	Fan Efficiency Per Cent	Manometric Ratio Per Cent	Volume Ratio Per Cent
1	0	0	3.260	42.2	80.0	85.0	38.5	0	0	95.3	0
2	25,000	347	3.175	41.7	86.0	87.0	41.8	12.5	29.9	92.8	79.5
3	52,000	722	3.225	45.5	88.0	88.0	47.2	26.4	56.0	94.3	165
4	68,000	945	3.300	49.2	88.5	90.0	52.5	35.4	67.4	96.5	213
5	85,000	1,180	3.375	54.6	89.5	91.5	60.0	45.2	75.4	98.5	267
6	105,000	1,460	3.400	62.5	90.5	93.0	70.5	56.3	79.9	99.4	333
7	118,000	1,640	3.360	69.3	90.5	94.0	79.0	62.5	79.2	98.2	375
8	140,000	1,945	3.130	83.8	90.5	95.0	96.6	69.0	71.5	91.5	445
9	158,000	2,195	2.810	98.5	90.0	95.0	113.0	70.0	62.0	82.0	500

Constant speed, 240 r.p.m.; temperature, 70 deg. F.; barometer, 29.5 in.

Third, the power requirements are at a minimum when the airways are entirely blocked and at a maximum when the fan is operating in free air —that is, without a mine connection.

Fourth, it would be wrong to condemn the fan, without making a careful analysis for not delivering its specified volume of air. The fan might be operating under conditions shown in Test No. 2, 3, or 4. If airways were cleaned up, the fan then would operate in accordance with Test No. 5, 6 or 7.

Furthermore, from the tabulations a fan curve can be prepared which gives a graphic picture over the entire range of the test. The accompanying curve was thus plotted from the data of the above test. The volumes are plotted along the horizontal. The pressure and brake horsepower data are plotted vertically at the left, and the mechanical efficiency percentage is plotted at the right.

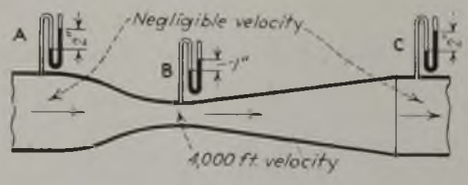
Bernouilli's Theorem Vital

Bernouilli's theorem is of such vast importance in mine ventilation and in the testing of fans that a discussion of it here appears advisable. It states that, when the air velocity is gradually increased or decreased from one point to another, the increase or decrease of the pressure is equal to the increase or decrease of the generative head of the air velocity. More broadly, it means that the sum of the velocity and static pressure heads remain constant, friction disregarded. Consider a Venturi meter constructed as illustrated in the accompanying sketch. In the section on which the gage *A* is mounted a 2-in. pressure is registered, the velocity being considered negligible. Suppose this tube is gradually contracted until a velocity of 4,000 ft. per minute is developed at gage *B*. If it be assumed that the air density is such that this velocity will develop 1-in. gage, then *B* will register only 1-in. pressure. Hence 1 in. of static pressure now has been converted into 1 in. of velocity pressure.

If the tube is now gradually expanded to gage *C*, where the velocity is considered negligible, then the gage at this point will read 2 in., as at *A*. It is assumed, of course, that during this experiment friction in the tube is disregarded and that conversion and expansion of the air is made without loss. Mine ventilation in practice is not without some friction loss and therefore the benefits offered by this theory are not altogether attainable. The theorem does show, however, that a gradual contraction and expansion of an airway or the passing of air across an overcast can be accomplished without a material loss of head, even if a decided contraction is effected.

Another lesson to be learned from this theory is in the measurement of the actual pressure produced by a blowing fan. Suppose that the fan is discharging air from the casing at a velocity of 4,000 ft. per minute and that a very gradual expansion is made from the fan to the mine; also that the velocity at the mine entrance is negligible. (It is assumed there are no losses of friction or conversion losses between the fan and the mine.) In order to complete the picture, let it be assumed that the fan is producing 100,000 cu.ft. with a 2-in. static pressure measured at the mine entrance, also that the load on the fan shaft is 42 b.hp., giving the fan a mechanical efficiency of 75 per cent.

If the pressure were read at the fan discharge with the gage connected to the static side of a Pitot tube, the gage would record only 1-in. static pressure; but as the velocity here is 4,000 ft., there would be 1 in. of velocity pressure, making a total pressure of 2 in. This reckoning would comply with Bernouilli's theorem, that the sum of the velocity and static pressure are always



Illustrating Bernouilli's Theorem With a Venturi Meter

equal. The principle is illustrated on the gradual expansion side of the Venturi meter in the sketch.

Were the efficiency of the fan in this case computed by taking into account only the static pressure and disregarding velocity pressure, the air horsepower derived (for 100,000 cu.ft. at 1-in. pressure) would be only 15.76. This divided by the actual brake horsepower, or 42, would indicate the fan as being only 37.5 per cent mechanically efficient, as against 75 per cent where the actual pressure produced by the fan was allowed.

This clearly indicates why a fan should be credited with the total pressure produced. There is a vast difference between a fan producing 37.5 per cent mechanical efficiency and one yielding 75 per cent, yet a discrepancy as wide as these figures indicate can arise in testing a fan when pressure readings are taken incorrectly.

If a dial-face anemometer is used for reading velocities under 500 ft. per minute, the instrument should be of the highly sensitive type; for velocities above 3,000 ft. per minute, a special high-velocity type should be employed. In measuring velocities between 500 and 3,000 ft. per minute, the standard 4-in. dial-face type will serve all practical purposes. It is often said that anemometers are unreliable and give inconsistent readings, but my experience with these instruments does not bear out these conclusions. Discrepancies probably are encountered, but these more often than not are the result of using anemometers which are not best suited to the velocities being measured. Measurement of velocities below 1,000 ft. per minute can be obtained more accurately with a vane anemometer than with a pressure gage unless sensitive manometers are used. Because the pressure equivalent of a velocity of 1,000 ft. per minute is equal to about 1/16 in. of water, the impracticability of using a pressure gage for the lower velocity heads readily can be appreciated. Besides being more convenient when properly used, the anemometer is capable of giving all the precision ordinarily required.

The calibration curve furnished with each anemometer is developed under ideal conditions and holds good only where the instrument is placed in a steady current, the speed of which is uniform across the whole vane circle. In practice these and other requirements seldom can be met, the reasons being as follow: (1) It is humanly impossible to hold the anemometer perpendicular to the air flow at all times; consequently the reading will be less than that obtained when the vane circle is perpendicular to the flow of air. (2) If the anemometer is held by hand, eddy currents are set up by the air striking the hand, so again less than the actual velocity will be registered; more accuracy is obtained by holding the instrument with a screwed-in round handle, thereby partially eliminating eddy currents. (3) To get an average reading over the entire area, it is necessary to move the anemometer from one position to another many times during the reading period; this constant movement causes more or less baffling and again the velocity registered is less than it should be.

Why Fuss With Calibration?

In view of these facts the wisdom of making calibration correction of velocities registered by the anemometer is doubtful. If it were possible to duplicate laboratory conditions when taking velocities in the mine, the correction curve could be applied. This being impossible, it would appear best to accept the velocities registered without calibration as correct for all practical purposes.

In taking the readings the anemometer should be held upstream, or ahead of one's body, and off to one side. It is important not to have any obstruction in the plane of measurement. When this precaution is taken, no deduction in area should be made for one's body. The velocity should be an average obtained by following the recommended practice of dividing the cross-sectional area into equal squares and taking a reading in the center of each for a given period of time. If the number of squares

(Turn to page 341)

ARTIFICIAL RESPIRATION

+ By Holger Nielsen Method

Increases Air Reception

By H. WALTER PYE
London, England

ARTIFICIAL respiration, so important a remedial measure for apnoea—that is, partial or complete suspension of breathing, resulting from industrial accident—has been given a new peak of efficiency and simplicity. A Dane, Holger Nielsen, has recently made public the details of his new method which competent Danish authorities, drawn from medical and industrial fields, affirm inflates the lungs with each respiration 90 per cent more than the Schaeffer method.

He bases his method on the principle that, when treating a man or woman in a state of apnoea, the lungs of the patient should be freed from the noxious substance with which they are filled and the natural process of respiration should be restored as rapidly as possible. Mr. Nielsen, sports inspector for the seaside community of Gjentofte, a suburb of Copenhagen, and thus brought into frequent contact with cases of apnoea, noted, many years ago, that neither the Schaeffer nor the Silvester method fulfilled all the requirements of an ideal system of resuscitation. He noted that, though the Schaeffer method could restore the mechanical function of breathing far more rapidly than the Silvester, the latter gave a far greater depth of respiration. Mr. Nielsen's conclusion was that by combining the chief merits of the two systems he could undoubtedly create one of greater merit.

Could Not Combine Both

But this could hardly be accomplished by a simple combination of the physical treatments of the two. He shortly found that the inclusion of these seemingly opposed merits in one system would require a completely new physical program. The ideal system needed to be as simple as, if not simpler than, the Schaeffer, capable of being performed by one unassisted operator without mechanical contrivances of any sort, and in a posture which insured that the glottis would

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Interview with E. von Holstein Ratblou, professor in electro-techniques, University of Technology of Copenhagen; member of board of directors, Danish Red Cross.

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not be blocked by the tongue. It would be necessary to induce a respiration at least double that of the Schaeffer method while maintaining a frequency not far below it and thus have as a result the dual effect of clearing the lungs more rapidly than was normally considered possible and of causing the respiratory system to respond correspondingly faster to the rapid and deeper stimulus.

Patient Lies as With Schaeffer's

Mr. Nielsen decided to retain the posture of Sir Edward Schaeffer in his investigations, this being an obvious improvement over the supine posture of Henry Silvester and requiring no manipulation of the patient's tongue, which is a distinct disadvantage with the latter system unless administered by a fully trained person. Again, to deepen each respiration as greatly as desired, he could hardly work with the bolster introduced by Benjamin Howard, who adapted the Silvester method without noticeable success, for this method lessened the chest pressure of the patient's torso when at the same time he was trying to force the chest to expand and contract almost to its fullest capacity. Finally, to maintain a frequency hardly second to Schaeffer's, he had to accomplish the deepened inspiration within $2\frac{1}{2}$ seconds, so that the whole movement could be completed within 7 seconds.

He proceeded to investigate means of inducing in a senseless person a respiration similar to the deep breath one takes when one expands one's chest to its fullest capacity before an open window of a morning, for only by approximating that abnormal ventilation could he hope to achieve his object. He had often noted the cleansing and freshening effect of a few such deep breaths, but he found their application to forced, involuntary breathing a long and difficult task to accomplish.

At last, after years of patient research and endless experiment, he arrived at a simple means of gaining the desirable effects simultaneously. In respect to the posture of the patient's body, the Schaeffer and Nielsen methods are similar, but they differ radically with regard to the position of the operator and to his movements. With the new method the operator kneels at the head of the patient, instead of astride his hips, places his pressure on the shoulder blades instead of lower down on the rib structure, and at the conclusion of each pressure the operator slides his hands along the patient's arms and raises them slightly. This simple action, seemingly inconsequent, is the very crux of the Nielsen method, for it removes the weight of the torso and makes the chest expand so greatly as to cause the lungs to accept 90 per cent more air in each respiration than is possible with the Schaeffer method.

Approved by Danish Red Cross

Upon the successful completion of the method, its inventor turned it over to Prof. Arnold Krogh, Nobel Prize winner of the Rockefeller Institute in Copenhagen, an investigator famous for his researches on the respiratory processes. Professor Krogh tested it exhaustively, on actually insensible persons, and as a result of his tests gave the method his unqualified indorsement. He further called attention to the fact that he had found the simple shoulder pres-

sure alone, without the "lift" of the arms, to be 10 per cent more efficient than the rib pressure of Schaeffer.

Following Professor Krogh's indorsement, the new method was officially investigated by a special commission of trained men drawn from the faculty of medicine of the University of Copenhagen, the State Board of Public Health, the Danish Red Cross, the Danish Life-Saving Association and other interested bodies.

The results of this official investigation were shortly made public and its findings are numerically stated in the accompanying table.

Following this official approval, the Danish Red Cross formally adopted the new method, advised its widespread use in all industrial undertakings in which artificial respiration is needed and prepared rules for its performance for distribution among Danish industries, written for use in the treatment of victims of apnoea from electric shock, gas, smoke, etc. These are as follows:

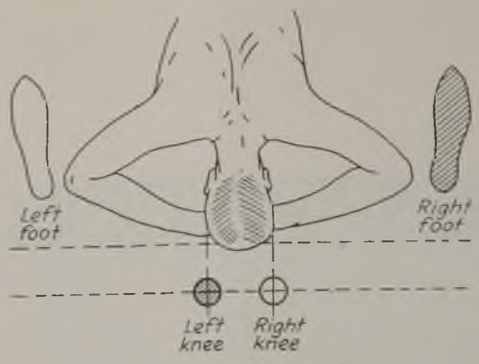


Fig. 1—Position of Feet of Operative

Danish Red Cross Rules for Holger Nielsen Method

Many minor details of the treatment, chiefly in regard to care of the patient before and after artificial respiration has been applied, are similar to those embodied in the rules established for the Schaeffer and Silvester methods. These are sufficiently well known to need no description. The essential rules for the correct performance of the new method are:

If rescuer is alone, he shall start resuscitation immediately and send for a doctor and ambulance only when others have come to his assistance. If help is long in coming, patient may then be removed to the nearest house.

Remove outer clothes, and quickly loosen all garments that restrain breathing such as collar, belt, corset, brassières, knee garters, etc. Lay patient face down on a flat, hard surface. If surface slopes, keep head at lowest point. Bend patient's arms at elbows, cross hands flat over one another and place them directly under the patient's forehead.

Place a handkerchief under hands and face, if possible, to prevent dust entering and to keep nose and mouth clear of the ground. Place heavier cloth or coat near head for operative's knee. Then, placing himself at the head of patient, the operative places one knee on the folded cloth near the patient's head and the other foot near his elbow (see Figs. 1-4).

The operative then slaps heavily with flat hands between the shoulder blades two or three times so that tongue will fall forward. If tongue does not fall forward, the operative must then open patient's mouth and

Fig. 2—Starting Position. Note Position of Hands, Foot and Knee.

Fig. 3—Expiration; Arms Vertical, No. Muscular Effort

Fig. 4—Inspiration; Swings Back, Thereby Lifting Arms

Method	Frequency Per Minute	Depth of Each Breath	Per Cent Increase Per Breath	Ventilation in Lungs Per Minute	Per Cent Increase Respiration
Silvester	5.8	1.6	60	9.4	0.0
Schaeffer	9.4	1.0	0	9.4	0.0
Nielsen without "lift"	9.0	1.1	10	9.9	5.3
Nielsen with "lift"	7.1	1.9	90	13.3	41.5

draw it forward. At all times he must be certain that the tongue remains forward and downward.

Starting Position—The operative lays his hands with outstretched fingers on the patient's back so that his palms are just on the shoulder blades and the wrists just over the top edge (see Fig. 2).

Expiration—Operative commences artificial respiration at once by swinging his body forward, swinging freely from the hips, with his arms straight and stiff. He moves slowly and with progressive pressure. The pressure is to be made only by the weight of the operative's body and must be free of muscular force. He continues pressure and forward movement until arms are vertical. Operative holds this position while counting "one—two—three—four" and on the beat of "four" he releases pressure by swinging his torso backward (see Fig. 3).

Inspiration—Operative then moves his hands along the patient's shoulders and arms until he can grasp the middle of the patient's forearms. He now swings slightly backward again, causing the patient's arms to lift a little. Only the arms of the patient may move in this second movement, his head and torso remaining entirely undisturbed. The arms are held in the "lift" position while the operator continues his count "five—six—seven—eight." This second movement is again performed entirely without muscular effort. The patient's arms must be lifted entirely without bending or lifting of the operative's arms and hands. They remain straight and they are lifted solely by the backswing of the operative's torso (see Fig. 4).

Double Movement Repeated

At the count of "eight" the operative returns his hands to the starting position and repeats the double movement. He repeats these double movements seven to eight times in each minute. The first movement, the pressure on the shoulder blades, must last 2½ seconds, while counting to "four," and at the count of "four" pressure must be released and the operative's hands must slide to the patient's arms. The "lift" commences with "five" and is continued during 2½ seconds again, until the count of "eight." The count must be made slowly and evenly, and the eighth count should be made 7 seconds after the first. This allows a full 2½ seconds each for both pressure and "lift" and exactly sufficient time for an unhurried, easy change from first to second position and back again. There is no reason for fast working. The count must be made slowly and evenly. If any difficulty should be experienced in the counting, a watch may be used during the beginning of the resuscitation.

The treatment must not be discontinued until after at least four hours of steady, unremitting resuscitation, unless, of course, the patient commences to breathe strongly and naturally of his own volition.

The basis of the method is form and rhythm. A rhythmic, easy, rolling movement can be continued almost indefinitely, if the operative makes certain of the balance of his position. This, of course, may be slightly adjusted during the first few double movements until he finds himself working without effort. Above all, the operative must not work rapidly. If he becomes tired, he may change the position of his feet as shown in Fig. 1.

Artificial respiration shall be continued well after the patient first gives signs of life by exhibiting the ability to breathe slightly by his own efforts, but from this point on the operative must discontinue the second movement, or "lift." He continues, however, only applying and relieving pressure on the shoulder blades, thus speeding his frequency of movement to nine to ten times a minute. If the "lift" is continued after this point, the patient can be seriously overventilated, causing a great diminishment of the carbon dioxide, CO_2, in the blood, and resulting finally in a total inability to breathe.

If a carbogen apparatus can be procured and brought to the scene, it may be used at once. The mask may be put over mouth and nose, and the movements continued as described above, without change in movement or speed. It is advisable to employ the carbogen apparatus at 3-minute intervals—that is, open for 3 minutes and then closed during 3 minutes. When the apparatus is not functioning during alternative 3-minute intervals, the mask immediately should be removed so that patient can breathe in ordinary air whether by force or voluntarily. If the apparatus is in the hands of a trained operator, he may continue the "lift" of the arms, if desirable, even after the first signs of life but only during the alternative intervals when the machine is functioning.

To this I would add that if experiments are made on unasphyxiated persons, it is advisable that care be taken regarding the number of full pressures and "lifts" given, as the patient can be seriously overventilated and as a result may suffer from after effects.

WHAT FAN TESTS SHOW
In Mine Ventilation

(Concluded from page 338)

is 20 and the duration of each reading 12 seconds, the total time would be 240 seconds, or 4 minutes, so that the velocity per minute would be the average of the readings divided by 4.

The water gage and volume passing tell more about mine conditions than will days of inspection travel underground, but do not watch the water gage in the hope that its reading will point out roof falls and other ventilation disturbances. The practice of keeping close tab on the volume passing at a particular pressure is much safer, as closing of the air passage entirely may have little effect on the water gage.

As simple as the construction, functioning, installation and reading of the water gage may appear, mistakes in its handling frequently are made. Such remarks have been heard as, "The fan will not need to work against any water gage because the mine is dry inside." Individuals have been seen also attempting to read the gage by taking the depression or rise of water in one leg only. Naturally, in that case they read only half the actual gage produced. The true gage, obviously, is the difference in the height of the water columns in the two legs. An inch of water gage means that a pressure of 5.2 lb. per square foot is exerted on the airway. Why? Because a cubic foot of water weighs 62.4 lb. and a square foot of water 1 in. deep will weigh 5.2 lb.

The pipe or hose leading from the gage and subjected to the mine pressure should not extend down the air shaft but terminate between the air shaft and the fan. The end of the pipe must not face the velocity generated by an exhaust fan. **It should be installed** at right angles or, better still, in some location comparatively free from air velocity.

The connection between the gage and mine for a blowing fan is directly opposite to that for an exhaust fan. The end of the pipe should head into the air velocity—face the fan—and be installed between the fan and the air shaft. A good location for the pipe for a reversible fan is in the center of the airway directly in front of and close to the front reversing doors.

The water gage should be located so that one leg of the tube is fully exposed to the atmospheric pressure. If the gage is placed in the motor or engine house, be careful to have a door or window open when reading it. Otherwise the readings may be very inaccurate, especially on an exhaust fan. This is because the house is more or less subject to the mine pressure by reason of leakage through the wall between house and fan drift.

Care must also be taken to see that the gage and its connection to the air passage of the mine do not leak. A small leak will give a decidedly inaccurate reading. In addition to a water gage every mine should be provided with a recording gage. The latter protects the mine owner in case of an explosion by offering evidence of the continuity of fan operation.

NOTES
From Across the Sea

WITH fewer mines in operation—203 in 1932 and 200 in 1933—and fewer working points—6,917 in 1932 and 6,287 in 1933—German coal production increased from 104,740,331 tons in 1932 to 109,920,682 tons in 1933. Less underground machinery (see table) seems to have been used in the year 1933 than in 1932, because of the reduction in the number of mines. "Fewer and better mines" seems to have been the slogan in Germany, as it has been here. However, the decrease in the use of machinery cannot be definitely determined because figures are not available as to the number of prime movers in use.

MACHINERY USED IN GERMAN MINES

	Number of Machines		Horsepower	
	1932	1933	1932	1933
Drilling equipment	25,398	22,187	23,275	20,281
Coal-cutting equipment	66,057	64,294	68,325	57,459
Gobbing equipment	136	145	1,770	2,148
Ventilators	10,547	9,871	12,696	8,609
Pumps	4,886	4,499	604,359	598,103

Thus only gobbing equipment showed an increase.

Germany, however, has reached almost saturation as far as mechanical operation is concerned, so any decrease in the number of mines operated is likely to be reflected in a reduction of mine equipment units and horsepower. Thus the Ruhr district mines 96.3 per cent of its coal mechanically. In 1932, Lower Silesia held first place; Aachen, Saxony and Upper Silesia follow in the order named.

Pneumatic picks weighing less than 8 kg. (18 lb.) declined in number from 21,842 in 1932 to 20,277 in 1933; those weighing more than 8 kg. increased from 42,358 to 42,751, which seems to show a preference for the heavier equipment. Coal-cutting machines, variously designated as rotating cross-cutting machines, chain cross-cutting machines, rotating cross-cutters, chain cross-cutters, coal-cutting machines, pillar cross-cutting machines and other machines, declined from 1,802 in 1932 to 1,258 in 1933. The drift from undercutting to complete reliance on pneumatic picks, so often stated, seems by these figures to be confirmed.

Growth in the use of gobbing machines is restricted to the pneumatic type. In 1932 there were 113 at work, and in 1934 the number had risen to 124, and they backfilled 6,336,000 cu.m., or 223,762,176 cu.ft. Only 21 slushing machines were used in 1933, as against 23 in 1932, stowing in the latter year 4,333,000 cu.m., or 153,024,228 cu.ft., showing clearly that dry stowing is rapidly displacing wet, thus saving pumping expense, danger of flooding from bursting pipes, and wear and tear of lengthy pipe lines.

Only four main ventilators were in use within the mines in the whole of Germany during 1932. In view of the article by F. C. Cornet in *Coal Age* of November, 1933, pp. 365-366, describing the placing of mine fans underground in Belgium, it seems significant that three more main fans (or seven in all) were working in the German mines in 1933 than in 1932. These seven had a total horsepower of 450. In addition there were 5,103 special or auxiliary fans in 1933, as against 5,624 in 1932—probably bearing witness to the decrease in the number of working points, which declined by 630. Number of ventilating pipes also dropped from 4,919 to 4,761. As evidence of a vast improvement in ventilating economy, the grand total of ventilating power capacity decreased from 12,696 hp. in 1932 to 8,609 in 1933.

It is in loading machines that the greatest difference between the United States and Germany is to be noted. Of loaders, Germany, which had three loading coal in 1932, had only one in 1933, and eight loading "barren" material in 1932 and fourteen in 1933. Twenty-two scrapers were loading coal in 1932 and only seventeen in 1933. Twelve scrapers were gobbing in 1932 and only eight in 1933; sixteen in both years were handling rock. Of self-discharging cars, doubtless for the transport of gobbing material, there were 38 in 1932 and only five in 1933, but apparently that was not because there was a trend back to tippling of cars, for cars of this type in gobbing work also dropped from 388 to 273. Of drive units for shaking conveyors, there were 7,969 in 1932, as against 6,115 in 1933. Counter conveyor units for giving the reverse movement to conveyers, which probably are unknown in this country because of our lower-duty shakers, were 856 in 1932 and only 838 in 1933. Belt conveyors numbered 366 and 435 for the two years, respectively, showing a suggestive increase, as in this country, but flight chain conveyors numbered 359 and 333 and showed a decrease. Retarding conveyors numbered sixteen in 1932 and 35 in 1933, showing a large gain.

Symptomatic of difficulties in haulage, there were 3,820 underground hoists in 1932, but only 2,782 in 1933. Of underground slope hoists, there were 2,504 and 1,846, respectively, and in road operation there were 9,220 in 1932 and only 8,797 in 1933. Just what these hoists are is not clear—probably merely for spotting cars, for rope hoists numbered 946 in 1932 and 667 in 1933. Of chain hoists there were 346 in 1932 and 352 in 1933, for once an increase.

Direct-current locomotives were 1,527 in 1932 and only 1,319 in 1933. Alternating-current locomotives — equipment not used in the United States—were 39 and 40, respectively. One storage-battery locomotive is declared to be for trolley operation. It probably operates on the same principle as the combination locomotive in American practice. All other mobile haulage units declined in numbers except those using raw oil; these increased from 87 to 134. Storage-battery locomotives dropped from 214 to 186, compressed-air locomotives from 994 to 831, benzol locomotives from 385 to 285.

For these figures we are indebted to J. Patterson, American Consul, Breslau, Germany, and the Department of Foreign and Domestic Commerce, but little of the comment is thus to be attributed.

OPERATORS are beginning to awake to the fact that the danger of silicosis arises not so much from the drilling as from the blasting of siliceous rock. Operatives need protection in both these occupations. At a Cumberland mine in Great Britain, a successful effort recently was made to reduce the dust due to blasting. Though the experiment was conducted in a hematite and not a coal mine, the results are equally significant for all those who have to cope with harmful dust. One would suppose that in anthracite mines, with their heavy blasting in hard material, the means of control would have to be set further back from the face than is customary at this mine. Otherwise, the means adopted would seem to be equally applicable. This system of allaying dust is now standard practice at these workings.

A roll curtain, says T. C. Futters, in the *Colliery Guardian,* is erected about 40 ft. back of the face, and about 10 ft. therefrom between the curtain and the face a dust-allaying ejector designed by C. Wetherill is fixed by a spring clip to a post in the middle of the road. This ejector receives compressed air at one end and draws a regulated quantity of castor oil, or some other dust-wetting agent, from a container, and as the air passes toward the nozzle it draws in water. The mixture as a fine spray is discharged in the face of a shot. According to reports, it completely dispels the cloud of dust from the shot and also col-

lects the fumes, so that men can return to the face after a delay of only 10 minutes. As the ejector is loosely retained in place by the clip, if ejected particles should hit the former it will not be destroyed but merely displaced. A small chain attached to the post supports the compressed-air hose. Thus far the ejector has never even been dislodged. Water, when used alone, is undesirable because it does not wet the fine dust and merely creates a fog which helps to keep the dust in suspension.

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. Where no price is appended in the notice of a publication of the U. S. Bureau of Mines, application should be directed to that Bureau. 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.

Contributions to the Study of Coal — Mineral Matter of No. 6 Bed Coal at West Frankfort, Franklin County, Illinois, by Clayton C. Ball. Report of Investigations, No. 33, Illinois Geological Survey, Urbana, Ill. 106 pp.

"Everything white in coal is calcite," declares the average mining engineer, but it may not always be so, and this monograph of Clayton C. Ball shows that in No. 6 bed at West Frankfort the whitish material is usually not calcite but kaolinite, which is fortunate, for alumina and silica have high fusion temperatures. The kaolinite occurs both in detrital clay and as a prominent filling in cracks caused by the drying of the peaty or coaly mass and in the fusain cavities in the coal. Below the blue band which is characteristic of No. 6 bed, calcite predominates, but above it, and throughout the bed taken as a whole, kaolinite is in the ascendant.

The latter mineral may be coated with a thin film of calcite and will effervesce, thus convincing the average investigator who does not use microscopic methods that it *is* calcite and not kaolinite with which he is dealing. Apparently the coal dried again after the kaolinite first entered the shrinkage cracks, as more than one layer of kaolinite or calcite may be found. The kaolinite has been identified in its optical properties, chemical analysis, dehydration curve and X-ray diffraction pattern.

Though calcite, pyrite and kaolinite constitute 95 per cent of the mineral matter, quartz, feldspar, garnet, common hornblende, apatite, zircon, muscovite, epidote, biotite, augite, kyanite, rutile, staurolite, topaz, tourmaline and chloritic materials also are found—nineteen minerals in all. At State College sixteen minerals were noted (*Coal Age*, March, 1934, p. 106) and among these were diaspore, limonite, magnetite, gypsum, hematite and siderite, which are not in the Illinois listing. Apparently the No. 6 coal bed in Illinois lacks oxides of iron. Similarly in Illinois were found hornblende, apatite, epidote, biotite, augite, kyanite, staurolite and topaz, which are not in the State College list.

This publication discusses the possibility of selective mining, which it says has not been practiced in Illinois except to leave a scale of coal near the floor, more for cutting-machine practice than as means of improving the mined product. This practice at New Orient, however, decreases the ash content of the coal as mined. The extraction of a selected portion of the coal bed, amounting to 86 per cent of the coal now mined, would provide coal with 1 per cent less ash and that ash would be of a more refractory composition.

Consideration also is given to the problem of obtaining a unit heat value for coal, which knowledge of its actual mineral constitution makes possible. The Thiessen formula is identical with the Parr formula except that it corrects for the presence of calcite. In every instance where calcite is present it increases the mineral-matter-to-ash ratio. This formula is: Mineral matter = 1.08 ash × 0.9 carbon dioxide × 0.55 sulphur.

An Automatic Firedamp Recorder, by H. Lloyd. Safety in Mines Research Board (British), Paper No. 86. British Library of Information, New York, N. Y. 19 pp. Price, 17c.

Firedamp percentages might be measured by the specific gravity of the gas mixture, for methane is half as heavy as air, but 5 per cent of methane lowers the density only $2\frac{1}{2}$ per cent, which is hardly sufficient for effective indication, especially as much smaller percentages should be noted. Density has an effect on rate of diffusion and on the acoustic properties, but the inconvenience of providing a supply of pure air for comparison and the delicacy of the apparatus needed to apply this principle discourage its application. Optical density is the basis on which the interferometer works, but the instrument is expensive and bulky and would be more so equipped as a recorder. Inflammability methods in the presence of a catalyst, with temperature rises measured thermometrically, thermo-electrically, by resistance variation, photometrically or by radiation methods, have been favored, but catalysts soon become ineffective by adsorption.

One automatic firedamp recorder has a heated filament of platinum or palladium inclosed in a porous chamber placed in an atmosphere of firedamp. The methane burns continuously on the surface of the filament, reducing the pressure in the chamber according to the methane present, but the products of combustion interfere with its accuracy over any long period. In the recorder devised by H. Lloyd, of the S.M.R.B., herein described, the methane is completely burned and the change in volume and pressure records the methane content. The bulletin describes the manner in which this is done, but the instrument is elaborate and specially designed for research purposes. The Board declares that "it would not be suitable for examinations of collieries for firedamp, but it may have other useful applications." It might, it seems, be used to measure the percentage of methane in a return.

The Routine Method for Determining the Inflammability of Mine Dusts: A Modified Form of the Test, by A. L. Godbert. Safety in Mines Research Board (British), Paper No. 87. British Library of Information, New York, N. Y. 16 pp. Price, 17c.

The test described is made by blowing a gram of the dust through a heated tube by a blast of oxygen and observing whether it inflames; the temperature of the tube is so adjusted that the result of the test is comparable with that of a test made in the 4-ft.-diameter gallery at Buxton, England. One form uses an electrically heated tube but another has a gas-heated tube for laboratories where electric heating is not convenient, the first being the more easily controlled and giving the more precise results. The heated tube is horizontal and of transparent silica 7 in. long, an internal diameter of $\frac{3}{4}$ in. and $\frac{1}{16}$-in. wall. Tests have shown that incombustible dusts have different effects in prevention of combustion and explosion of coal dusts, so that the mere percentage of inert dust is not the answer. This method tests the inflammability of the mixture independent of the character of the inert dust.

OPERATING IDEAS

From Production, Electrical and Mechanical Men

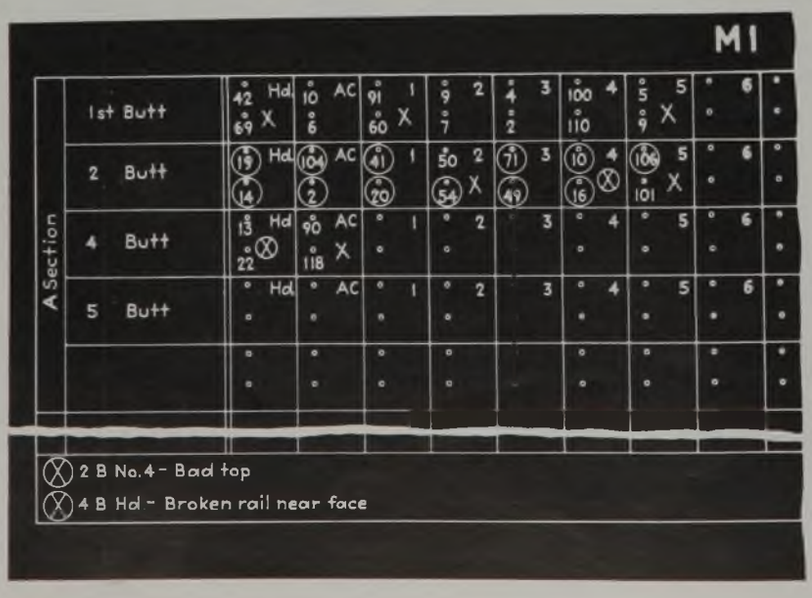
Foreman's Problems Simplified By Checkboard Design

A checkboard when properly designed and used may be an effective tool for the mine foreman in securing maximum operating efficiency, declares Walter Iman, Kitzmiller, Md., who installed the board shown in the accompanying illustration while foreman at the Vindex (Md.) mine of the Manor Coal Co. The board is laid off in squares, each square corresponding to a working place. Working places are identified by abbreviations of the words "Heading" or "Aircourse" or by room numbers painted in the upper right-hand corner of each square. At the left of each square are two nails to accommodate two checks (one nail would be used where only one man works in a place). Check numbers are painted directly below the nails and these numbers are in all cases the numbers of the men working in the particular places, being changed as often as necessary. Quick-drying paint is used for this purpose, and allows the old number to be covered with black and the new number to be painted on in white immediately.

When the place and check numbers are painted in each square, space remains at the lower right for the use of the miners in reporting places ready to cut. If a place has been cleaned up, the men (or man) mark an X with chalk in the blank space at the time they remove their checks. Machine men therefore can get the list of places to be cut by inspecting the checkboard before going on shift. Also, the checkboard can be made to show what places were not cut and why by instructing the machine men to put a circle around the X for each place not cut, as in No. 4 room, 2d Butt, and write the reasons for not cutting at the bottom of the board—in this case "Bad top."

The board therefore gives information to both the miner and the foreman at the beginning of the shift. In case the place is not cut, the miner knows he must wait to see the foreman to find out if work will be available, and the foreman, in turn, by consulting the board, can determine whether there are absentees whose places can be filled for the day. In the case just cited, it is possible to send one of the men normally employed in No. 4 room, 2d Butt, to No. 2 room and the other to No. 5. Both No. 2 and No. 5 therefore can be cleaned up and cut, and in case the absentees return the following day the men in both places will have a full day's work. In the meantime, opportunity is afforded for making No. 4 room safe in preparation for cutting.

Details of Vindex Checkboard



With this board, says Mr. Iman, he was able to tell at the beginning of each shift how many miners were working, who they were and where they were, how many were absent and who they were and the condition of each working place. By instituting a supplementary system of reports of reasons for not working, considerable improvement in the absentee record was secured. The board also proved of value in a number of other directions. When certain averages of working time were desired, a record was kept of the checks removed every hour. Leaving as a result of cleaning up was immediately apparent from inspection of the board and other reasons were ascertained by requiring reports, thus yielding the necessary information. Drivers and motormen also found the board helpful in determining quickly where men were working and what places had full cuts. In case a man was injured, painting his number in red was of material assistance in provoking discussion of preventive measures and instilling a regard for safety.

Drag Stays Off Ties Until Needed

Safety dogs, or drags, attached to the rear ends of trips to prevent runaways generally are designed to drag on the ties with some exceptions, one being the drag developed at the Dresser mine of Walter Bledsoe & Co., Terre Haute, Ind., for use at the New Jellico mine of the New Jellico Coal Co., Morley, Tenn. As indicated in the accompanying illustrations, this drag is designed to ride in the air until the trip starts traveling in the opposite direction, whereupon it is allowed to drop to the track through the action of a trigger coming in contact with a tripping block spiked to a tie.

The drag is designed for attachment to the drawbar, as shown, and to prevent it from turning to one side or the other a cross member resting against the end of the car is welded on, as indicated. A holding pin passing through a hole in the steel dividing plate between the two thrust members and into a corresponding hole in the supporting arm holds the thrust members in the air while the trip is proceeding upgrade. During this process, the trigger, which is free to rotate on a pin, rides over the tripping

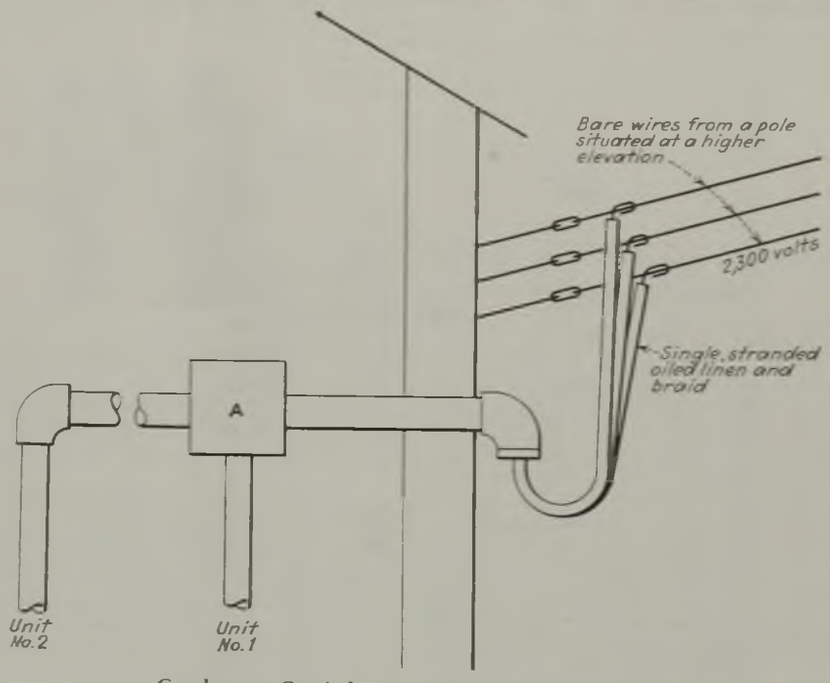
Drag in Normal Position, With the Trigger Blocked Up to Show How It Clears Tripping Block in the Center of the Track.

Trigger About to Strike Tripping Block.

Stopping a Trip. Thrust Members Have Dropped to the Track, Showing Supporting Arm and Pin.

blocks on the ties. If the trip starts back, however, the trigger catches on the first tripping block it meets and jerks the holding pin back, allowing the thrust members to fall to the track. A hickory pin is inserted in a hole in the trigger near the pin on which it revolves, and as the trigger is forced back this pin shears off and allows the trigger to pass over the tripping block without throwing strains on the other parts of the drag or interfering with the action of the thrust members.

The ends of the thrust members are split and the upper portion is turned back, as shown. This permits the drag to function even if the thrust members —as occasionally is the case—are bent back under the car by the weight of a heavy trip or the effect of stopping cars which have picked up some speed. Tripping blocks are spaced about 50 ft. apart and are spiked in the center of the track.



Conductors Carried Water Into the Junction Box

Line Connection Should Be Lower Than Entrance

Difficulties recently encountered at a substation of the Gauley Mountain Coal Co., Ansted, W. Va., illustrated that the connection from line wires to a condulet entrance should in many cases entail more than the simple precaution of arranging the usual drip loop. The possibility of the insulation acting as a hose and conducting water up through the drip loop should always be considered.

The accompanying drawing indicates the general arrangement of a substation entrance with which W. T. Dalton, chief electrician and master mechanic of the Gauley Mountain Coal Co., reported he experienced difficulties from entrance of water. First trouble appeared as an insulation breakdown in junction box *A*. In a short time, after an electrician repaired and retaped the joint in the box, a repetition of the failure occurred.

Naturally, this second occurrence pointed to faulty work by the electrician who made the repairs, but a careful investigation showed that water was entering the core of the cables at the points where they were soldered to the bare wires of the lines. Stranded conductor and oiled linen favored the chance for water to travel around conductors and into the junction box.

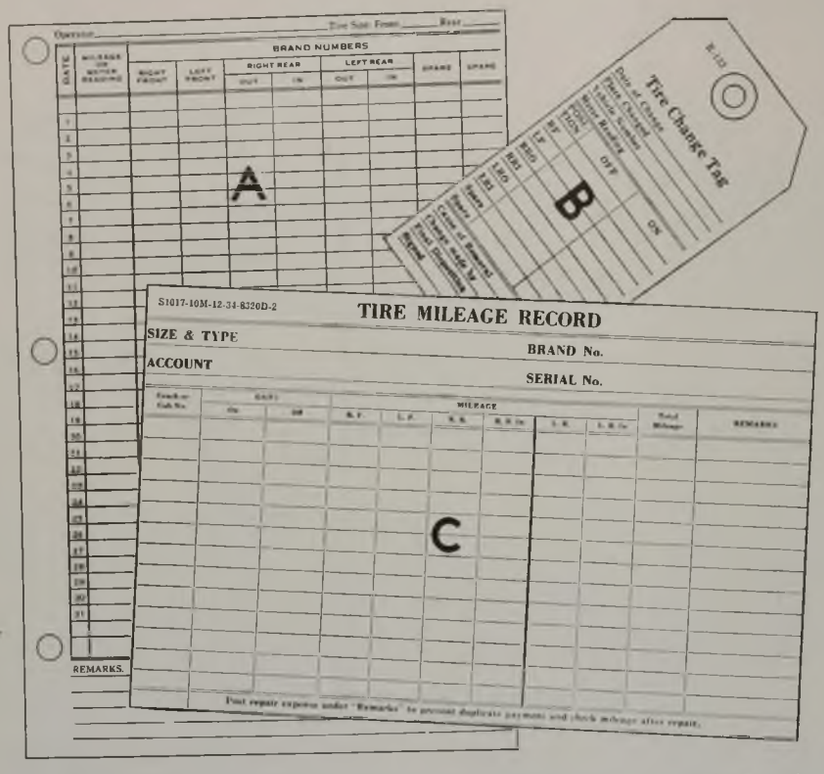
Because the point of attachment to the line was higher than the entrance conduit, water was forced up through the drip loop when the accumulation became sufficient. The condition at this substation was aggravated, apparently, by the fact that it is situated on a hillside and the line wires slope downward to the building wall, thus causing an excess quantity of water to run down to the soldered joints.

Obviously, to preclude any chance for insulation to act as a hose or tube, the point of attachment to the line wires should be lower than the entrance condulet. Several other methods present themselves, but none is so simple or so sure as arranging for these proper elevations.

Mr. Dalton is of the opinion that this hose effect of the insulation may explain certain cases of water entrance into transformers. Apparently that possibility is the greatest with stranded conductor and oiled-linen insulation.

No Time

Consequences have a habit of following immediately after trouble at coal mines. In many cases, however, the consequences become greater in magnitude the longer the trouble is allowed to continue. This naturally offers the possibility of checking the spread of the damage, but also requires a solution ready to hand. Such solutions may be acquired either first-hand by previous experience with similar occurrences, or second-hand through records of cause and remedy at other mines. This department is devoted to examples in the latter classification from operating, electrical, mechanical and safety men, and solicits your ideas or experiences. If you have licked a troublesome problem, send us the solution, together with a sketch or photograph if it will help in making it clearer. *Coal Age* will pay $5 or more each for acceptable ideas of this nature.



A—Monthly Report for Each Truck; B—"Tire Charge Tag," Attached to the Tire When Removed by the Driver; C—Tire Record, Showing Mileage on Various Trucks in Various Positions.

Keeping Tire Records For Lower Cost

While most coal operators will say offhand that they know the per-mile cost of tires and other truck equipment, this cost may not be the rock-bottom figure necessary for maximum efficiency unless proper records are kept, the Firestone Tire & Rubber Co. points out. Keeping such records is a relatively simple activity compared with the results that may be expected in the form of lower costs.

"The truck driver's part in record keeping should be very simple," according to the company. "He should have a report card to turn in with the truck, checking the listed items of supplies needed or parts needing attention. For tires, the truck driver needs only a 'Tire Change Tag,' which he puts on the tire as it comes off the wheel and which is dropped in the report box for the office to tabulate. This tag gives the serial number of the tire, date of change, place of change, vehicle number, speedometer reading, position in which the tire came off and position in which it went on, cause of removal, who made the change and final disposition. At the office the tag is used to make up, each month, the vehicle record, which shows the daily speedometer reading of the vehicle and the serial number of each of its tires on that day. This vehicle record is used to make the tire mileage record for each tire during its entire life, and shows the mileage of the tire on any truck and in any position it has served.

"This record will show at a glance: (1) rapid tread wear and on what wheel position it occurred; (2) mileage from various makes of tires; and (3) the only accurate tire costs. From the record can be traced premature tire wear and its causes. If a tire is worn out at 12,000 miles, or sooner than the average, and has been on a front wheel, misalignment or mechanical irregularity is indicated and can be corrected.

"The record shows how good maintenance is and how it can be improved. Garage personnel know that it is their job to get more tire mileage by maintaining proper air pressure, by putting smooth tires on the inside when duals are used, by putting the new tires on front and by rotating tires for more miles.

"But the records will show how well this is done. The records will show what tires to buy—for cost per mile, not purchase price, is the business basis of cost. Other truck records similar to those for tires can be kept. But tire records alone will show how to prevent unnecessary expense, delay, and accidents, and will add a substantial fraction to the necessary margin of profit in the coal business."

Unshielded Lamps Provide Better View of Track

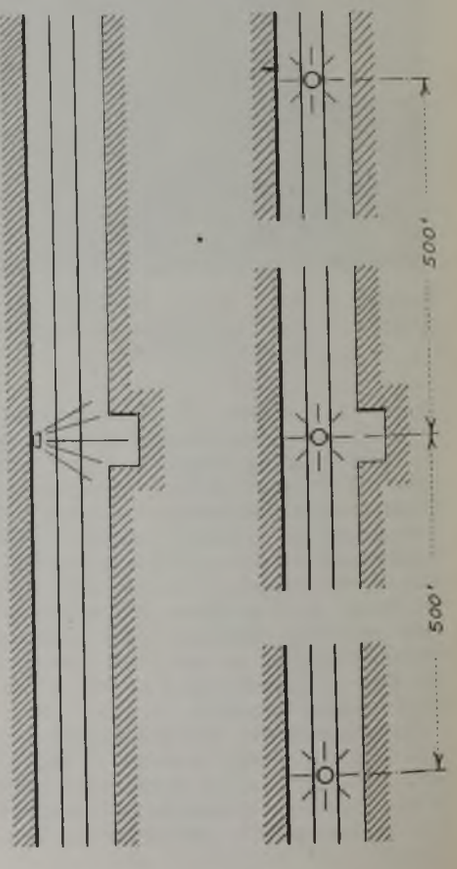
Inherent natural difficulties have limited progress in underground illumination by electric lamps connected to the power lines. Only in the last few years have illumination engineers generally appreciated the importance of eliminating contrast resulting from spots of high and low illumination intensities within the normal range of vision. A change of practice in illuminating the main haulway in No. 9 mine of the Carbon Fuel Co., Wevaco, W. Va., illustrates the detrimental effect of high contrast and emphasizes one of the inherent difficulties which have slowed illumination progress in mines.

In 1930, when No. 9 was reopened as a 100 per cent mechanical operation inside and out, modernization of the main haulway included a new method of lighting. This illumination, which apparently represented a progressive step, consisted of angle reflector units mounted high on the rib side opposite the manholes. The reflector shielded the lamp from the eyes of approaching motormen and confined the light to a short section of the entry at the manhole.

In so far as illuminating the manholes from the standpoint of indicating them as safety shelters for men walking or working on the haulway was concerned, the arrangement was excellent. From the standpoint of the motormen, however, it was worse than a total absence of stationary lighting. In the words of a motorman, it was "impossible to see through the dark spots between lamps."

After an extended trial which resulted in complaints by the motormen, the mine management changed the illumination to lamps mounted above the center of the track and devoid of reflectors. The spacing is 500 ft. and the size of lamp being used at present is 200-watt. Although the unshielded lamps do produce some glare in the eyes of the motormen, the direct rays reflect from the shiny top surface of the rails, making the track discernible for at least 500 ft. ahead. This reversion to an old method is but an indication that it is still the most practical for the specific condition.

Plan Views of Haulway Showing Angle Reflector Method (Left) and Latest Installation (Right)



WORD FROM THE FIELD

Alabama Coals Organized; Agency for Indiana?

Alabama Coals, Inc., filed articles of incorporation in Birmingham, Ala., July 8. Operators producing 81 per cent of the commercial tonnage in the State are stockholders, and the incorporation provisions are said to be broad enough to include also southern Tennessee and Georgia producers, which have been invited to join the organization.

Herbert S. Salmon, former Presidential member of Division III code authority, is president of the agency, and N. E. Cross, formerly secretary of the divisional code authority, is secretary. Directors are W. Carson Adams, Porter Coal Co.; C. S. Bissell, Black Diamond Coal Mining Co.; R. T. Daniel, Cane Creek Mining Co.; Charles F. DeBardeleben, Alabama Fuel & Iron Co.; P. H. Haskell, Jr., Alabama By-Products Corporation; A. R. Long, Brookside-Pratt Mining Co.; George F. Peter, Southern Coal & Coke Co.; David Roberts, Jr., Brilliant Coal Co.; B. F. Roden, Roden Coal Co., and D. A. Thomas, Montevallo Coal Mining Co.

Companies affiliated with the agency at the organization meeting were: Aetna Coal Co., Alabama By-Products Corporation, Alabama Fuel & Iron Co., Black Creek Coal & Coke Co., Black Diamond Coal Mining Co., Blocton Mining Co., Brilliant Coal Co., Brookside-Pratt Mining Co., Cane Creek Mining Co., DeBardeleben Coal Corporation, Deepwater Black Creek Coal Co., East Pratt Coal Co., Galloway Coal Co., Hammond Iron Co., Hills Creek Mining Co., Little Gem Coal Co., Montevallo Coal Mining Co., Paramount Coal Co., Porter Coal Co., Red Diamond Mining Co., Roden Coal Co., and Southern Coal & Coke Co.

July also brought reports that Indiana operators are taking kindly to the agency idea. A number of details for an agency to be known as Indiana Coals are said to have been worked out, but completion of the scheme is expected to await the outcome of legislative plans affecting the bituminous coal industry.

Operators Attack Patman Bill

John D. Battle, executive secretary of the National Coal Association, and Julian Conover, secretary, American Mining Congress, attacked the proposed Patman amendment to the Clayton Act at a hearing before the House Judiciary Committee on July 19. Primarily designed to regulate chain grocery stores, the proposed amendment is so broad in scope, according to Messrs. Battle and Conover, that it would prevent the sale of any commodity of like kind and character, regardless of quantity, at different prices. Quantity prices or discounts based on quantity would be disallowed and all commodities would be required to be sold to all purchasers, if of the same grade and quality, at the same price.

Pointing out the inflexible character of the bill, Mr. Battle strongly opposed such regulation with respect to bituminous coal; the anthracite industry took a similar stand. Representative Patman declared he had no intention that the regulation apply to coal, and suggested that an amendment be presented. Thereupon Mr. Battle asked the Judiciary Committee to insert a proviso in the bill that it would not apply to the mining or sale of coal.

New Preparation Facilities

New contracts and construction of preparation facilities were reported as follows in July:

Gunton Coal Co., Bernice, Pa.—Contract closed with the Wilmot Engineering Co. for breaker machinery to prepare 500 tons of coal per day, including Wilmot-Simplex Type A jigs, roll crusher, Parrish sizing screens and miscellaneous machinery.

Jacobs Fork Pocahontas Coal Co., Crafts, W. Va.—Contract closed with Jeffrey Mfg. Co. for four-track tipple equipped with shaker screens, picking tables, loading booms and refuse conveyor; also mountainside retarding conveyor.

Lehigh Valley Coal Co., Hazleton Shaft and Spring Mountain collieries—Contract closed with Wilmot Engineering Co. for Hydrotator installation to prepare No. 4 buckwheat, including dewatering screens and pumps. Old-style Hydrotator tanks are being replaced with new "duo-sloping-bottom" units with second-stage recleaners.

Snow Hill Coal Corporation, Snow Hill mine, Terre Haute, Ind.—Roberts & Schaefer Co. reports closing contract with Marion Steam Shovel Corporation for complete coal-cleaning equipment for 3/8x0-in. coal for installation in Snow Hill plant.

Sycamore Coal Co., Cinderella, W. Va.—Contract closed with Roberts & Schaefer Co. for complete coal-cleaning equipment, including Stump air-flow unit for 3/8x0-in. coal; capacity, 100 tons per hour; to be completed Sept. 1.

Westmoreland Coal Co., Irwin, Pa.—Contract closed with Roberts & Schaefer Co. for addition to existing coal-cleaning plant involving hydroseparator equipment to handle 150 tons additional of 3x¾-in. coal per hour.

Study of Coal-Code Operation Planned by NRA

Plans are under way by NRA for a detailed study of the actual results of operation under the bituminous-coal code. The objective is to use the vast accumulation of statistical data in the archives of the coal section to develop a factual picture of what happened during the 21 months the code was in effect and to supplement this presentation with a picture of the position of the industry prior to Oct. 1, 1933. In this way, NRA officials in charge of the work believe that the agency can make a real contribution to a better understanding of the industry and its problems.

Among the phases of the subject tentatively set up for study are costs, realizations and price correlations. The over-all picture on costs and realizations already has been released in the published reports based on Form A for November, 1933, to January, 1935. But these and other reports contain a large quantity of basic material which can be used to present more specific studies of various phases of cost and realizations by districts and by classes of mines. The same may be said of reports on wage rates and earnings. In addition, during the period of code operation NRA developed a number of other studies for its own guidance; for the most part, none of these studies has been published, but all the data will be available for this final review.

This report, which is one of a series of studies NRA is making of code operation in major industries, will be compiled under the general direction and supervision of F. E. Berquist. He will be assisted by a staff of specialists who also have been intimately associated with code developments. The report, it is emphasized, will be wholly factual in its basis and will be designed to present a clear and impartial picture completely divorced from propaganda.

Old Timers Parade and Dine

Bigger and better than ever was the verdict of those in attendance at the eleventh annual reunion of the Union Pacific Coal Co. Old Timers' Association, held at Rock Springs, Wyo., June 22. The meeting started with a business session, followed by the customary parade with music by the famous McAuliffe Kilties, brass bands from Rock Springs, Reliance, Winton, Superior and Hanna, and a bugle corps from Hanna. A band concert and field sports featured the afternoon.

At the annual banquet, eight hundred members were present. T. S. Taliaferro, Jr., an Old Timer, was the toastmaster,

Winning First-Aid Team at Union Pacific Coal Co. Meet

and addresses were made by President McAuliffe and Chief Justice Ralph Kimball, of the Wyoming Supreme Court. Three veterans, John Doak, Sr., Oliver C. Buehler and Thomas J. Morgan, received 40-year buttons from Mr. McAuliffe. There also was singing and dancing until midnight.

The field day events which preceded the Old Timers' reunion were featured by a large turn-out of first-aid teams. The team from Superior B, C, and E mines took first place with 498⅔ points out of a possible 500; Winton No. 1 was second with 496⅓, and Hanna No. 2 took third with 494⅔. Hanna boy scouts topped their division with 496 points and senior girl scouts from Hanna led with 498. Junior girl scouts from Superior had a perfect score. One-man first-aid events were won by W. H. Walsh and Sam Gillilan, of Superior.

Holmes certificates of honor were awarded to the Superior C mine for operating from Oct. 21, 1933, to Dec. 31, 1934, without a lost-time accident; to Rock Springs No. 4 mine for running from April 17, 1923, to Dec. 31, 1934, without a fatality, and to all the company's Wyoming mines for reducing fatalities per million tons from 4.94 in 1923 to 1.25 in 1934 and for reducing deaths per thousand men employed from 5.27 to 1.68 in the same period. E. H. Denny, U. S. Bureau of Mines, made the presentations.

TVA Victorious in Court of Appeals; Amended Bill Goes to Conference

TVA emerged victorious in two skirmishes during the last month, an appellate court decision upholding the constitutionality of the act and the lower house of Congress agreeing to amendments to the bill desired by the administration. The Fifth Circuit Court of Appeals, sitting at New Orleans, La., ruled on July 17 that the act creating TVA was valid, six days after the House had approved by a vote of 277 to 100 the administration's amendments extending the scope of the power "yardstick" project.

The appellate tribunal's decision reversed a ruling by Judge W. I. Grubb, in the U. S. District Court of northern Alabama, which annulled contracts between TVA and the Alabama Power Co. for the sale of government manufactured power in seven northern Alabama counties (April *Coal Age*, p. 172). Not only did the appeals court decision declare the TVA act constitutional but ruled that Congress had conferred the necessary statutory power on the power agency.

Validity of the act was challenged by preferred stockholders of the Alabama Power Co. who sought to nullify contracts between TVA and the power company in which the latter agreed to sell to TVA transmission lines extending from Wilson Dam into seven Alabama counties. It was further provided that the power company would offer to sell its distribution systems in that territory. TVA was to have the right to furnish power to any of the municipalities regardless of whether the company had sold the systems after three months from the date of the contract.

Judge Grubb, in the U. S. District Court, held that TVA was assuming to exercise authority which no act of Congress could constitutionally confer upon it and enjoined seventeen municipalities from executing contracts with TVA and from accepting PWA funds for the construction of power plants, on the ground that "TVA was engaged in illegal competition with the Alabama Power Co."

Citing as the basis for Judge Grubb's decision his conclusion that "the program of TVA for the manufacture and disposal of surplus electric power bore no substantial relation to any lawful government function," the appellate court decision held:

"Congress, in the exercise of its power, under Art. IV of the Constitution, to dispose of property belonging to the United States, may dispose of water power created at Wilson Dam as freely as it may of any other government property. It never heretofore has been held that the right of disposal exists only as to such part as it accidentally produced in excess of the amount strictly necessary for purposes of national defense or of navigation, but always that right has been supposed to extend to all the excess or surplus.

"It is within the province of Congress to adopt any reasonable means, whether of lease or sale, for disposing of the surplus. The use of transmission lines to facilitate sales cannot fairly be said by the courts to be unreasonable or inappropriate.

"Of course, it is true that the Government of the United States cannot engage at will in private business, but it by no means follows that it cannot sell property which it owns, even though in doing so it may enter into competition with other public or private owners of property. . . .

"It does not appear that TVA in respect to its operations at Wilson Dam is doing or proposes to do anything more than is authorized by the act. This being so, its motives are immaterial."

There will be an appeal to the U. S. Supreme Court, but as this tribunal is not in session during the summer months, it is likely that six months will have elapsed before the validity of the project is finally decided.

The day after the Court of Appeals decision it was announced at PWA headquarters in Washington that $796,000 would be made available at once to the northern Alabama cities of Florence, Tuscumbia and Sheffield for constructing distribution systems to use TVA power. Loans and grants to other municipalities are expected soon.

With Directors Morgan and Lilienthal in the gallery, the House, on July 10, voted approval of the administration's amendments to the TVA act by 277 to 100. As passed by the House, the measure differs from that already approved by the Senate in only one particular. A provision in the Senate bill permits TVA to increase its bond issuing capacity from $50,000,000 to $100,000,000, the proceeds to be used to purchase private utility properties, to be resold to States and municipalities desiring to embark on power projects. The bill as approved by the House retains the $50,000,000 limit without power to employ the funds for refinancing the sale of private properties to cities and States.

The points of agreement in the Senate and House bills are as follows:

That TVA should not be hampered by putting its rates on a profit-making basis during the early years of its operation;

That it should have a veto power over any future dams or developments in the Tennessee River or any of its tributaries;

That it might continue to construct power transmission lines wherever it deems necessary, even if these lines should duplicate existing private facilities.

Senator Norris, sponsor of the TVA project, obtained consent to substitute the Senate bill for the House measure when members of both houses got to work on an agreement in conference. Backers of the measure profess to be confident that reconciling the two versions in conference will be relatively simple.

Modernization—Watchword of Coal Mines In Canada's Maritime Provinces

MODERN CONVEYOR longwall loading methods in a North American coal field that exported coal to Boston, Mass., at least 40 years before Father Hennepin discovered coal in what is now the United States* and preliminary features in the starting of longwall operations, with studies of recent important steps in the progress of mining and wasteful factors in the mining industry, constituted the coal items in a two-day session of the Mining Society of Nova Scotia at its 48th annual meeting, June 26-27, at Pictou Lodge, Pictou, N. S.

As early as 1639, said A. D. King, general manager, Minto Coal Co., Minto, N. B., and J. J. Johnson, superintendent, Avon Coal Co., also of Minto, in a paper jointly presented, coal was being exported from the Grand Lake coal field of Queens and Sunbury counties in northwestern New Brunswick, and in 1643, when the two French rivals, La Tour and Charnisay, fought for dominance at St. John, one of the vessels engaged by La Tour at Boston sailed to the north side of Grand Lake and took off a cargo of coal for Boston. This same seam, having from 24 to 30 in. of actual coal and being 36 in. to 48 in. thick (and even in one section 6 ft. 1 in.) including the clay band, is being mined today with longwall faces 400 to 600 ft. long. The greatest cover is 125 ft., but the coal occasionally comes to the surface and at the mine of the Avon Coal Co. the coal, which is 30 in. net, is covered by 42 ft. of overburden, 17 ft. being soft and fractured and the other 25 ft. being a quicksand.

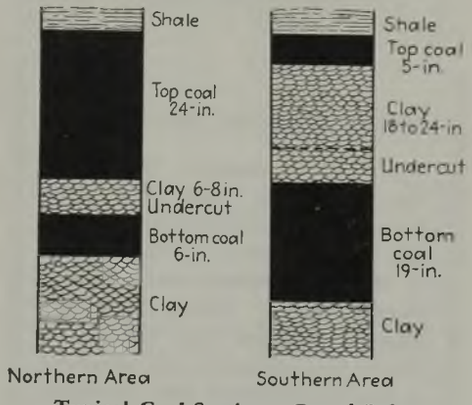
Stripping Started in 1905

In 1905, J. S. Gibbon Co. started a stripping using a clamshell bucket, and in 1917 two strippings were commenced, one by the Rothwell Coal Co. and the other by the Reed Construction Co. on behalf of the Minto Coal Co., the latter operation being equipped with a dragline. The burden in this strip mine ran from 6 to 22 ft. and was easy digging; the seam was 30 in. thick and of exceptional quality. The spoil was cast over to one side, the shovel or dragline digging into the high wall on one side of the strip pit and moving the spoil into the place where the coal had been excavated by hand labor.

Until 1921 all the underground working had been room-and-pillar operations, ventilation being by natural draft and all coal being hand-mined. The Minto Coal Co. in that year introduced longwall machine mining with Mavor & Coulson chain machines in place where the cover was 85 ft. The coal was brought to the gatehead by a shaker conveyor. The roof at the face was supported by 2x6-in. timber 6 ft. long at 30-in. centers, one end of which was hitched in the face and the other supported by a post. Line "straps" (crossbars) were laid parallel to the face supported by a line of props.

*According to the reports of the Illinois Geological Survey, credit for the first discovery of coal south of the international boundary line goes to Joliet and Father Marquette, who reported the presence of the mineral in the Illinois valley in 1673. Hennepin's discovery was in 1689.—EDITOR.

Where in the mines of the Avon Coal Co. the coal and immediate roof are covered by 25 ft. of quicksand, as stated, the shafts were sunk by driving 6x6-in. posts spaced 4 ft. apart with a one-ton pile-driver. To keep out the quicksand these posts were lined at the back with tongued-and-grooved sheathing, also driven. But this coal was mined by rooms 12 ft. wide, and the pillars were extracted by the usual method. The soft top was stripped off and 1-in. sawn boards 6 in. wide were driven ahead about 3½ ft. and supported by split timber propped at either end. Yet several shafts were worked in this area successfully. A number of washouts were



Typical Coal Sections, Grand Lake Coal Field

encountered and sometimes overthrusts, so that boreholes often passed twice through the same seam. The overthrust seam was mined in some instances to a limited extent.

Power is now used from the plant of the New Brunswick Electric Power Commission, which buys a quota of coal from all mines of the field; the plant is located at Newcastle Landing, on the north shore of Grand Lake. Some of the companies operate on the longwall advancing system and some by retreating longwall; the latter drive their roadways 40 ft. apart, forming panels 400x450 ft. which are mined by longwall retreating. In the Avon Coal Co.'s mine these narrow roadways are driven with a Goodman L-12 track-mounted machine. The Rothwell Coal Co. drives them by hand.

Where the clay band, as in the northern area, appears 6 in. above the bottom and is 6 to 8 in. thick, this clay is cut out by machine. In the southern area, the clay being thicker, usually 18 to 24 in., a machine cut is made in the clay over the lower bench of coal, here 19 in. thick, and the remainder of the clay is removed by hand and gobbed in the longwall. The top coal is removed by hand and loaded on conveyors; the bottom coal is then lifted and similarly loaded out. The 6-in. undercutting in the clay band across a longwall face 350 ft. long requires from 80 to 100 machine picks, as the clay is extremely hard and abrasive. Here, because of the excessive quantity of material that would have to be loaded out, the great thickness of the clay renders it impossible to operate advancing longwall.

To reduce the comparatively high accident rate a code of safety regulations was promulgated, which in 1933 was embodied in the provincial law. A full-time safety engineer was appointed, and accidents are decreasing. The Minto Coal Co., said the authors, has recently installed 200 Edison electric lamps in order to increase the efficiency of its workmen.

In 1923 shaking screens, picking tables and a crusher were installed by the Minto Coal Co., and in 1932 a slope 300 ft. long on an angle of 15 deg. was constructed and an up-to-date bankhead built. This contains a single-roll crusher, a three-deck vibrating screen and five picking tables. Eight one-ton-capacity steel cars constitute a trip. Four longwall faces are in operation. The cars are hauled underground by a main-and-tail-rope system. Some small operations still work the coal by room-and-pillar methods and hoist the coal by horses.

Discussing the geology of the field, W. J. Wright, provincial geologist of New Brunswick, said that the Pre-Pennsylvanian Coal Creek formation of interbedded slaty shales and sandstones standing at a pitch of about 60 deg. were covered by red and gray quartzose conglomerates, probably of Pennsylvania age, 0 to 50 ft. thick, forming the Newcastle formation. With no evidence of any erosion this was covered by a sheet of amygdaloidal basalt from 0 to 100 ft., and then without erosion apparently come 300 ft. of sandstones and conglomerates, forming the lower member of the Grand Lake formation. Above this is 75 ft. of the middle member with the coal bed described and 100 ft. of the upper member. This ends the Pennsylvanian. More measures may have been deposited only to be eroded, for erosion has been considerable. The Pleistocene period covered the ground with glacial drift and wore away parts of the Pennsylvanian deposits, sometimes to the coal and sometimes even below. Occasionally the coal seemed to be protected from erosion by its greasy nature. Over the 0 to 50 ft. of glacial drift came alluvium, soil and swamp deposits.

High in sulphur (7.1 per cent) and in ash (17 per cent), the coal is of true bituminous rank, having 31.4 per cent of volatile matter, 56.0 per cent of fixed carbon and 1.1 per cent of moisture when heated to 105 deg. C.; the fuel ratio is 1.7 and the calorific value 12,840 B.t.u.

Many Shafts and Sidings Needed

In discussion it developed that because of the difficulties of operation, new shafts and new sidings are made every 1,500 to 2,000 ft., the old plant being moved over to the new location. In places, to carry off the water from swags, ditches 6 ft. deep have to be made and boxed. Longwall faces are subject to dips which have to be drained by pumps. The conveyors adapt themselves well to the undulations of the strata. Pyrite in the clay adds to the difficulties. Longwall methods and mechanical undercutting enable the coal to enter the local market, causing an increase in annual tonnage of 400 per cent since 1910. After the clay has been removed the coal has to be supported. Sometimes when the support is removed the coal falls of itself, but sometimes a quarter stick of Monobel is used, the coal being removed in 4-ft. lengths.

Some of the casual methods of mining in the small mines were described. A man

putting on a load at the foot of the shaft cries "giddap" to the horse at the head of the shaft, which then proceeds to lift the load, stopping when the load reaches the top. A man busy haying near by then returns to the shaft to discharge the coal.

In his presidential address, A. L. Hay, assistant mining engineer, Dominion Coal Co., said that the average depth of cover of the coal being worked by his company was 1,440 ft., the average thickness was 5.70 ft. and the average haul 2.95 miles. Taking the British fatality rate on the exposure basis as unity, the fatality rate in Nova Scotia was 2.1 and that of the United States, 3.3, but recent experience in the province had been bad. For 11 fatalities in 1932 and 10 fatalities in 1933 there had been 26 in 1934. The rate per compensable accident had been 6,350 tons in 1933 and only 4,000 in 1934. Men should be taught by both instruction and example; not only must safety methods be inculcated but the principles also on which they rest.

A symposium on the greatest recent step in advance in any phase of the mining industry was introduced by R. D. Hall, engineering editor, *Coal Age*, with advances of the chemical industry as the aforesaid step. Rejecting hydrogenation as too costly a method for present conditions, he showed how low-temperature carbonization has advanced in the United States and detailed the many ways in which coal products have already begun to supply many of the manifold needs of industry and convenience. L. F. Crawford, mining engineer, Goodman Manufacturing Co., declared mechanization the premier step and showed how machines had loaded, at first, 200 tons per day, and with improvements in method and equipment 300 to 325 tons per day, and, lastly, with mines laid out for adaptation to the machines, as much as 500 or 600 tons per day. With wages based on $5 and with $7 per day as the high wage, 70 men under these favorable conditions had produced 20 tons per day underground, with a coal cost for loading of 20c. per ton and an over-all cost, including washing, of 48c., whereas with hand loading and mechanical cutting the latter cost was 65c. per ton.

Concentration Most Recent Step

Concentration, said Mr. Hay, was the most important recent step. Though concentration was possible without mechanization, the introduction of machines had been the "handmaid of concentration." Capt. J. G. Ross, president, Canadian Institute of Mining and Metallurgy, described the block caving system he had introduced in his gold mines, and F. W. Gray declared that only the fear that the sea might come into the mine had prevented an effort being made to introduce block caving at one of the Cape Breton mines of the Dominion Coal Co.

Discussing the second problem as to waste, Mr. Hall stated that much loss occurred from snap judgments of a management too busy to collect the data on which a considered judgment could be formed. He described the establishment of research departments in some United States mines and the methods and forms adopted for the collection of data regarding the performance, life and reliability of machinery as a means of devising policies of operation, repair and purchasing.

At Wildwood, Pa., said Mr. Crawford, a man was appointed to follow the operation of the machine with lowest production, to report on the reasons for its low tonnage and to suggest means for correction. This machine having been brought into line, the man passed on to the next low-capacity machine until all were up to a maximum of efficiency. In the United States a cost man works under the foreman and superintendent in many mines in an effort to find the reasons for high cost. J. R. Dinn, division manager, No. 4 colliery, Dominion Coal Co., declared that the handling of dirty coal on the surface was a leading waste and another advocated the use of close-up compressors.

Valves, said W. D. Haley, mine manager, Nova Scotia Steel & Coal Co., Ltd., should be so constructed that they could be opened wide by the operative, for when hose was being dragged about in the coal much slack entered it, and if the valve could be opened only when connected to a machine, it would blow this coal into the cylinder when so connected, with consequent wear. Also, the air was used to blow borings out of boreholes before charging, and if air could pass in volume only when coupled to a machine, the holes could not thus be cleaned.

Though retreating longwall, declared H. Hines, district superintendent, Dominion Coal Co., New Waterford mines, results in less costly road maintenance if the seam is sufficiently thick and the roof is not too weak, ventilation may be difficult in a gaseous seam and deferred returns on the money expended in driving haulways and airways may constitute a further difficulty. Where belts are not used in the headings for the loading of the coal, a certain length of the heading will have to be maintained for a passing place for cars inby the retreating longwall face. Though this will be short, its maintenance may be difficult.

With advancing longwall the roads necessary for haulage and ventilation will have to be maintained in the gob, requiring heavy brushing and high maintenance cost. With the retreating-advancing system a main haulage level and an airway are developed on the solid, and a barrier of coal must be left to protect them. In this method the face advances outby-inward instead of inby-outward, as in true retreat. The barrier left can be removed on retreat later, but this involves complications. Experience at New Waterford mines has proved that a pillar 50 ft. thick is ample for a cover up to 1,500 ft., as the weight of the roof is released by the caving of the roof behind the longwall face.

Face Increases With Pitch

In Continental Europe, declared Mr. Hines, it has been found that when the pitch of the seam increases, the length of the face should be increased also for economical operation. After the first undercut, midwalls should be immediately started: the width of these depends on seam thickness, condition of immediate roof and depth of cover. They should be built to take up the pressure quickly and without undue shrinkage; but they should be spaced at such intervals that the immediate roof will fall as soon as the chocks are withdrawn. In starting the midwalls little or no fallen stone will be available, hence much wood must be provided, but as soon as stone is available it should be used.

Until the mining conditions are well understood, the distance between midwalls should be comparatively small, but it should be extended to that found most suitable as experience is gained. In the mines of the Dominion Coal Co., the immediate roof falls between the walls to a height about three times that of the seam thickness; the overburden settles gradually until the space is filled solid. Very hard roof has sometimes to be loosened or brought down by shooting, but only rarely does this happen in the Sydney coal field. A very weak roof may break so as to form a span greater than the distance between midwalls, which is undesirable. Distance between midwalls should be adjusted so that the walls will be the springing points of the arches.

On machine-cut faces coal cleavage may cause lines of weakness and breaks will

Who's Who in Nova Scotia

J. R. Dinn, manager, No. 4 colliery, Dominion Coal Co., Glace Bay, N. S., was elected president of the Mining Society of Nova Scotia at the 48th annual meeting, last month. N. T. Avard, managing director, Maritime Coal, Railway & Power Co., Amherst, was advanced to first vice-president, and Alexander McEachern, chief inspector, Dominion Coal Co., Glace Bay, was made second vice-president. Sydney C. Mifflen, office engineer, Dominion Coal Co., Sydney, was reelected secretary-treasurer.

Members of the council of the society are: Michael Dwyer, Minister of Mines, Halifax; H. C. M. Gordon, assistant mining engineer, Acadia Coal Co., Stellarton; F. W. Gray, assistant general manager, Dominion Steel & Coal Corporation, Sydney; W. D. Haley, manager, Florence Colliery, Sydney Mines; H. Hines, district superintendent, Dominion Coal Co., New Waterford; H. J. Kelley, vice president and general manager, Dominion Steel & Coal Corporation, Sydney; D. H. McDougall, consulting mining engineer, Montreal, P. Q.; D. H. McLean, resident superintendent, Acadia Coal Co., Stellarton; J. W. McLeod, managing director, Greenwood Coal Co., Thorburn; J. C. Nicholson, general superintendent of mines, Dominion Steel & Coal Corporation, Glace Bay; W. C. Risley, construction superintendent, Dominion Coal Co., Sydney; H. W. Roscoe, eastern district manager, Canadian Industries, Ltd., Halifax; W. L. Stuewe, mechanical superintendent, Dominion Coal Co., Glace Bay.

occur along the face; for this reason the face should be at right angles to the cleats. Hardwood chocks, symmetrically placed and firmly wedged, of size and at centers governed by thickness of seam, pitch and character of roof, must be erected along the face as soon as space is available, and these must be removed completely at the right time, for a clean gob prevents collapse and loss of the face.

When the overburden apparently fails to lay its weight on the gob, even perhaps for a distance of 60 ft., the operator must not be lulled into false security and allow himself to reduce the number and width of the midwalls or he will face much trouble later, though in some favorable cases midwalls can be dispensed with, but if they can be, the line of support on the gob side must be made as strong as possible, and steel props are frequently used to this end. The tensional stresses of the roof increase with greater seam thickness, and a roof flexible enough to accommodate itself to the extraction of a thin seam may break with a thick bed to a great height and close the working face if not properly supported.

In the discussion, doubt was expressed whether advancing longwall was any better than retreating longwall in the handling of gas, but Mr. Hines declared that ventilation should strike the face before it strikes the waste, otherwise the gas from the waste will make the gas percentage too high at the face.

A.S.T.M. Reviews Coal Problems

Reports of coal and coke and classification committees and a paper on a new furnace and its use for the measurement of coal-ash softening temperature by E. P. Barrett were features of the 1935 meeting of the American Society for Testing Materials at Detroit, Mich., late in June. Committee D-5 recommended four new proposed standards which will be issued as tentative. One of these covers definitions of the terms "gross calorific value" and "net calorific value" of fuels.

Two methods of test for grindability of coal were presented, one by the ball-mill method, the other using the Hardgrove machine method. The first named describes a laboratory procedure for estimating the grindability of coal. The Hardgrove method is used to determine the relative grindability or ease of pulverizing of coals in comparison with a coal chosen as 100 grindabality.

A new method of test for screen analysis of coal was developed and recommended to Committee D-5 by Subcommittee VII on defining coal sizes and friability (J. D. Doherty, chairman) of the technical committee on coal classification of the sectional committee on classification of coals. The method applies to size testing of all coal with the exception of anthracite, powdered coal as used in boiler plants, and crushed coal as charged into coke ovens, methods for which are already standards of the society. The method represents the best American practice in size testing of coal to determine the distribution of various sizes in any given lot of coal. In addition to these new tentative standards, Committee D-5 proposed the adoption as standard of the Method of Sampling Coke for Analysis (D346-33T).

Federal Government Backs Modernization Loans As Part of Drive to Aid Industry

WASHINGTON, D. C., July 24—Federal government agencies are now engaged in a triple campaign to help business bridge the financial valleys carved out by the depression. An intensive drive to persuade industry to borrow for modernization and to encourage the banks to loan money for that purpose has been launched by the Federal Housing Administration. The Federal Reserve System is increasing its efforts to aid deserving enterprises in rebuilding depleted working capital. To a more limited extent, the Reconstruction Finance Corporation — the original federal pulmotor squad for the rescue of distressed industry—also is in the picture. RFC aid involves direct government loans; in the case of the other two agencies, funds are advanced by regular banking institutions, although, under exceptional conditions, the Federal Reserve System will make direct loans.

FHA is the latest agency to enter this movement. Originally created to assist the small householder, as a result of an amendment to the law increasing the maximum individual loan coming under the provisions of the act from $2,000 to $50,000, this agency is now extending its activities into the industrial field. As interpreted in the revised regulations of FHA, this amendment, approved May 28, permits:

> An advance of credit in excess of $2,000 but not in excess of $50,000 . . . for the purpose of (1) repair, alteration, or improvement of real property already improved by, or to be converted into, apartment or multiple-family houses, hotels, office, business or other commercial buildings, hospitals, orphanages, colleges, schools, or manufacturing or industrial plants, or (2) for the purchase and installation, in connection with the foregoing types of property, of such equipment and machinery, with or without any structural changes in the buildings, as are peculiarly adapted to the business conducted therein or necessary to the operation thereof.

Although mines are mentioned neither in the foregoing regulations nor in the language of the amendment, the present disposition of FHA headquarters is to construe the intent and purposes of the act broadly and to include loans to mining companies as within the purview of the law. Apparently, too, few restrictions will be placed upon the types of equipment which can qualify for loans under the act. Questions involving certain specific types are now under discussion and a definite ruling on their inclusion is expected within a few days. Marc G. Bluth, Committee of Ten—Coal and Heating Industries, and R. L. Scott, Anthracite Institute, are here in Washington acting as industrial advisers to FHA on problems relating to the coal industry and to coal-burning equipment.

In view of the liberalization of the requirements under the original law, it is not believed that any bar will be set up against movable equipment in the application of the act to industrial loans. When the act was first passed, it was held that only equipment which was permanently attached to the building would qualify. Later the regulations were broadened to include movables such as gas and electric refrigerators. Arguing from this analogy, it is believed that loans on mining machines, loading machines and conveyors will be as acceptable as advances on hoists, substations, screens and other preparation-plant equipment, and track.

Under the National Housing Act, FHA is authorized to insure up to 20 per cent of the face value of the loans made for modernization purposes by the banks. Application for loans is made directly to the bank. The question of the financial condition of the borrower is left "to the reasonable judgment" of the financial institution as a credit matter. The borrower must submit a financial statement approved as to form by FHA "which in the judgment of the financial institution shows the borrower to be solvent, with reasonable ability to pay the obligation and in other respects a reasonable credit risk in view of the insurance provided by the National Housing Act."

Maximum Loan Five Years

Loans are to be covered by promissory notes and are to be repaid in monthly instalments. The maximum period for any one loan is five years. Banks insuring loans with FHA are not permitted to charge in excess of 5 per cent of the face of the loan. This maximum includes interest, discount, service charges and any other fees in connection with the loan. Notes, however, may also provide for a penalty of 5c. for each dollar for each payment more than fifteen days in arrears or for interest on overdue payments at a rate not exceeding the maximum legal rate permitted in the State where the loan is made. Exclusive of these penalty charges, the 5 per cent maximum on the face of the note is equivalent to 9.71 per cent on a long-term loan. This figure is said to be about half the usual charge on instalment buying.

The Federal Reserve System was given an active role in the rehabilitation picture by an amendment to the Reserve Act effective June 19, 1934. There was an immediate flood of applications for loans, but the majority of the applications, it was said, were made under a misapprehension as to the terms and purposes of the amendment or by would-be borrowers who could not justify the extension of credit. After the initial rush, little was heard of the operation of the amendment until a few weeks ago. Since that time, however, the Federal Reserve System has been actively pushing its service. As previously stated, most of the loans under the Federal Reserve System amendment have been made through individual commercial banks. These loans are for the purpose of providing working capital for established industrial and commercial enterprises and must be made on a "sound and reasonable basis." These loans also may extend over a period of five years.

In operating under the amendment,

Federal Reserve officials have endeavored to adopt a broad viewpoint. No attempt has been made to define the precise meaning of "reasonable and sound," "working capital," or "established business." The aim has been to leave as much as possible to the common sense of experienced bankers and business men and, as far as possible, to let each application stand upon its own merits. Industrial advisory committees of business men have been set up in each Federal Reserve district to pass upon applications for loans. While the Federal Reserve bank gives great weight to the committee recommendations, final decision is made by the bank and, in some cases, loans have been granted in the face of an adverse recommendation by the advisory committee.

A seeker after a loan under this amendment is required to fill out a formal application and also to supply definite information that his own bank will not lend him directly. If granting a loan seems desirable, every effort is made to induce the applicant's bank to make or participate in the loan. Each application is carefully but sympathetically investigated to develop all the facts necessary to determine whether a loan should be authorized. Personal character of the applicant and his community relationships, particularly from the standpoint of an employer of labor, are taken into consideration. In the first year of operation under the amendment, 6,571 applications for a total of $260,373,000 were received; favorable action upon 1,798 applications involving total loans of $100,751,000 was recommended by the industrial advisory committees; 1,636 applications involving $88,601,000 were approved by the Federal Reserve banks and advances of $31,447,000 made. Individual loans ranged from $250 to $6,000,000. Out of a total of $280,000,000 originally available for such loans and commitments the Federal Reserve System still had approximately $190,000,000 available on June 1.

Personal Notes

COL. J. H. GRAHAM, consulting engineer, who has been active in coal mining and former president of the Indian Refining Co., has been appointed dean of the College of Engineering, University of Kentucky. He was cited by General Pershing for meritorious service during the World War, receiving a Distinguished Service Medal, and was decorated by the French Government.

CHARLES F. JACKSON has been designated as acting head of the Mining Division of the U. S. Bureau of Mines in place of C. W. Wright, who has been assigned to a special European mission.

O. P. HOOD has been exempted from the retirement provision of the Civil Service law by an order issued by President Roosevelt. Had the order not been forthcoming Dr. Hood would have had to retire at the close of the fiscal year, having reached the age of 70 years. His service with the Bureau of Mines began in 1911 as chief mechanical engineer of the Bureau. He became chief of the technologic branch of the Bureau with its creation in 1927. Prior to his service in Washington he served thirteen years as professor of mechanical and electrical engineering at the Michigan College of Mines. He was a member of the class of 1885 at Rose Polytechnic Institute.

W. M. RITTER has resigned as president of the Red Jacket Consolidated Coal & Coke Co., Inc., and the Red Jack Jr. Coal Co. He will be succeeded by his nephew, E. E. RITTER, who has been vice-president and general manager of the two companies. The companies operate in southern West Virginia and their main office is in Columbus, Ohio.

B. W. SNODGRASS has been elected president of the Moffat Coal Co., Denver, Colo. He joined the company as vice-president and general manager in the autumn of 1934.

HENRY F. WARDEN, general superintendent, American Coal Co. of Allegany County, since 1926, has been advanced to the post of general manager of the company and of its affiliate, the Mill Creek Coal & Coke Co., vice Charles B. Smith, deceased. Both companies, which operate in the Pocahontas field of West Virginia, are subsidiaries of W. C. Atwater & Co., New York.

Bids Under NRA Approved

A joint resolution, sponsored by Senator Walsh, which authorizes government departments to award contracts on the basis of bids submitted before NRA was invalidated was passed unanimously by the U. S. Senate July 20 and sent to the House. It would also require bidders to agree that contracts would be subject to legislative action hereafter enacted by Congress regulating hours and wages (July *Coal Age*, p. 305).

Senator Walsh explained that bids invited prior to the Supreme Court decison nullifying NRA were on the basis of code provisions and that Comptroller General McCarl had ruled that awards could not be made on them. The Montana Senator said that to readvertise bids would cause much delay.

Wagner Labor Disputes Bill Signed by President

President Roosevelt on July 5 signed the Wagner-Connery National Labor Relations Act, enacting into law a federal authorization for labor to organize for the purpose of collective bargaining, a definition of unfair practices, and the creation of an organization to review disputes between employers and labor. Adjudication of disputes will be in the hands of a permanent National Labor Relations Board, which will supersede the group carrying the same title which was organized under NRA.

The effect of the law will depend largely on the personnel of the board, the manner in which the board attempts to apply the statute, and the interpretation placed upon it by the courts. Plans to test the constitutionality of the act probably will be centered on the clause in the measure stating that it "is applicable only when violation of the legal right of self-organization would burden or obstruct interstate commerce."

William Green, president, American Federation of Labor, characterized the act as the Magna Charta of labor, but advised affiliated unions to use caution in invoking its provisions in the following list of "don'ts":

"1. Don't file charges under the law unless the union has made an honest effort to get satisfaction from the employer through direct negotiations and met with no success.

"2. Don't file charges unless every other means of peaceful adjustment, including mediation, has been exhausted.

"3. Don't file charges unless you specificially refer to the unfair labor practices listed in the act.

"4. Don't file charges unless you are absolutely sure you have the facts sufficient to substantiate your charges and that you can produce witnesses able and willing to testify to those acts.

"5. Don't file charges if the employer is engaged in a purely local business and the case in no way affects interstate commerce."

Amended Alabama Mine Laws Would Promote Safety

A substantial increase in coal-mine safety and greater efficiency in mine inspections are the major objectives of revisions in the Albama mine law presented last month to Governor Graves for his assent, which was confidently expected. Of the 53 amendments to old laws, one of the most important is considered to be that providing for "the necessary number of associate inspectors to make a complete examination of gaseous mines every 45 days, or oftener, if necessary, and non-gaseous mines every 90 days, or oftener, if necessary." The old law based the number of inspectors on the tonnage produced. Number of inspectors under the new measure, however, is limited to eight, including the head of the department.

While efficient work with the limited force has characterized the State mining department under old regulations, it is expected that the increased personnel will not only result in better conditions at the larger operations but also will permit the requisite attention to be devoted to the several hundred truck mines in the State, which to date this year have accounted for approximately half of the fatalities.

The chief inspector is vested with authority to subpoena witnesses and administer oaths, thus allowing thorough investigation of accidents and infractions of the mine laws. Witnesses failing to appear when summoned, and to testify, are subject to contempt proceedings as in any court of justice. The various provisions of the law applying to mining practices and regulations for both operators and miners are tightened up and amended to achieve maximum safety and efficiency and to provide the chief inspector with adequate authority to enforce observation of rules and regulations and effectively prosecute infractions.

Industrial Burning Equipment

Analysis of the data on firing equipment and boilers used in 7,284 plants in Georgia, Indiana, Kentucky, Michigan, North and South Carolina, Ohio and Virginia is the subject of "Industrial Coal Burning Equipment," a new publication of Appalachian Coals, Inc., for distribution to its pro-

ducer-members and agents. General distribution is not contemplated by ACI. The analysis was made by the agency's fuel engineering division from data collected in the industrial survey undertaken by the research department in Georgia, eastern Indiana, central and eastern Kentucky, lower peninsula of Michigan, North and South Carolina, that part of Ohio west of the Sandusky-Galion line, and western Virginia. The publication is expected to provide an effective guide in preparation and application of ACI coals.

Kentucky Blast Kills Nine

Nine miners were killed July 17 in an explosion in Mine No. 5, Consolidation Coal Co., Van Lear, Ky. The bodies were recovered after rescue workers had worked for twenty hours in removing fallen timbers and slate to reach the men, who were a mile and a half from the entrance of the mine. The explosion occurred early in the morning while the maintenance crew was removing trackage in a worked-out section.

Four days after the disaster, John B. Mollette, secretary of the United Mine Workers local and chairman of a miners' committee, swore out a warrant for the arrest of John F. Daniel, chief of the State Department of Mines, on the charge of failure to enforce safety regulations. It was alleged that the safety laws require at least five firebosses to inspect the workings, but that there was only one at the mine when the explosion occurred.

Seek Gas Outlet in Detroit

Inroads on coal markets by gas threatened from two directions last month. Municipal officials of Detroit were in conference about the middle of July with the Columbia Gas & Electric Co. and Frank P. Parish in connection with a proposal to extend a natural-gas line, now running from the Texas Panhandle to Dana, Ind., into the motor city to serve industrial and, possibly, domestic consumers. The McKnab Oil Co., a developer in the Kansas field, is reported to be seeking a franchise to pipe natural gas into St. Louis and Detroit.

The Illinois gas tax bill, which provided for a tax of 5c. per 1,000 cu.ft. on natural gas, was defeated in the State Senate at Springfield late in June. The vote was 21 for and 17 against, but, as 26 votes were necessary to passage, the measure lost by 5 votes.

Coming Meetings

- Central West Virginia Coal Mining Institute: Fourth annual safety day and first-aid contest, Aug. 10, State Park, Jackson's Mill (near Clarksburg), W. Va.
- National Safety Council: 24th annual safety congress, Oct. 14-18, Louisville, Ky.
- Midwest Power Show: Oct. 14-18, Chicago, Ill.
- Coal Division of American Institute of Mining and Metallurgical Engineers: fall meeting, Oct. 28 and 29, St. Louis, Mo.

Guffey-Snyder Action Still Hangs Fire; Opposition to Bill Continues

WASHINGTON, D. C., July 25—Another act in the drama of subordinating the negotiation of new wage agreements in the bituminous fields to Congressional action on the Guffey-Snyder coal-control bill was played this morning when the reconvened conference of the Appalachian joint sub-scale committee held a brief session and adjourned until tomorrow morning. No official predictions were forthcoming as to the outcome of tomorrow's meeting, but observers of the progress of negotiations since last March inclined to the view that the program of marking time would be continued until the House Ways and Means subcommittee in charge of the bill makes its report. Unless this report or some definite statement on it is made before the present conference concludes its labors, the probability of another last-minute intervention by administration officials to effect a fourth temporary extension of the old agreements is strong.

Just when the subcommittee of the House Committee on Ways and Means will make its report on the Guffey-Snyder bill is somewhat of a mystery at the present time. Early in the week it was intimated that action on the bill had been sidetracked temporarily for the administration tax program and that it would be two or three weeks before the committee had concluded its deliberations on that program. Still later, after talking with the secretary of the committee, Secretary of Labor Perkins made the flat statement that the bill would be reported out this week. This opinion is held in a number of circles in Washington. In the House yesterday, however, Representative Treadway, a member of the subcommittee, took issue with this statement, declaring that, if the bill was ready to report, it was news to him. "I haven't heard anything about the Guffey bill in two weeks," he added. To which Representative Rich retorted that he considered Mr. Treadway's statement "a lot of guff."

Constitutionality Frets Committee

That the question of constitutionality has been deviling the subcommittee is no secret here. Certain Republican members of the subcommittee have been driving hard on that point and a letter from the President on July 5 requesting that the committee report out the bill regardless of conflicting opinions as to its constitutionality has not helped the situation. Both Representative Doughton, chairman of the committee, and Speaker Byrns have publicly admitted that strong opposition to the measure exists within the committee. Representative Hill, chairman of the subcommittee, has avoided public comment, and several other members have refused to hazard an opinion on the constitutionality phase.

Although no official word has been given out as to the changes the subcommittee will recommend, it is a matter of common knowledge that at least forty amendments have been proposed. Some of these are matters of detail, but others would vitally affect major provisions of the bill. There is a persistent rumor that Title II, providing for the establishment of a National Bituminous Coal Reserve, will be thrown overboard by the subcommittee. If this should happen, it is considered likely that the bill will provide, as in the case of allocation, that the Coal Commission make a study of the question for subsequent report to Congress. Such a change was proposed during the May deliberations of the National Conference of Bituminous Coal Producers, but was ignored in the final draft proposed by the conference.

Developments in July were prefaced by the hurried adoption of another temporary extension of wage agreements after the conclusion of hearings on the bill (p. 354) on June 28. The joint wage conference for the Appalachian region reconvened June 24 under the chairmanship of D. C. Kennedy, executive secretary, Kanawha Coal Operators' Association. Operators offered a proposal that present agreements in the Appalachian region and all other fields having contracts with the United Mine Workers be extended to March 31, 1936, subject to changes growing out of the elimination of inequitable differentials and providing that if the number of hours per day and per week, or either, be changed by legislative action, the "present hourly and piecework rates shall remain in effect." This proposal was rejected by John L. Lewis for the miners, who again presented their request for a 6-hour day and wage increases. The operators again refused their assent and the sub-scale committee of nine operators and nine miners was directed to continue negotiations.

Negotiations Fail Again

After several postponements, the full committee met on June 29 to receive a report that the subcommittee had been unable to reach any agreement, whereupon an adjournment was taken subject to the call of the chairman. Union headquarters immediately began preparations for calling a suspension on July 1 and district officials and operators began their homeward treks. At this point, administration officials, who had previously displayed little interest, took a hand, and in an evening conference Secretary Perkins informed Messrs. Kennedy and Lewis that it was the President's wish that the agreement be extended 30 days. Mr. Lewis agreed, subject to acceptance by the operators, and Mr. Kennedy contracted to ascertain the attitude of the operator groups. This turned out to be favorable, although certain groups, notably the Pocahontas Operators' Association, agreed under protest, stating that the union has refused an offer of a new agreement to March 31, 1936. As a result of the last-minute truce, work continued on July 1, although closings were reported in a few districts, where word was not received in time to halt the suspension.

With 30 days of grace, all parties settled down to wait for the action of the House subcommittee. This proved a

lengthier process than was anticipated, due to the hitch over the question of constitutionality and reported difficulties in revision. Attorney General Cummings and Solicitor General Reed appeared before the subcommittee on July 5 and, declining to express an opinion one way or the other on the constitutionality of the measure, advised it push forward and leave the matter to the courts.

President Roosevelt then took a hand, and in a letter bearing the date of July 5 to Representative Hill, chairman of the subcommittee, expressed the hope that "your committee will not permit doubts as to the constitutionality, however reasonable, to block the suggested legislation." The text of the letter is as follows:

> Your subcommittee of the Ways and Means has pending before it H. R. 8,479, "a bill to stabilize the bituminous coal-mining industry and promote its interstate commerce," &c., and I understand that questions of the constitutionality of some of its provisions have arisen in the subcommittee.
>
> This industry, from the standpoint of the operators and the miners, has had many years of difficulty. The product is a great natural resource entitled to the consideration of Congress both as to the conditions under which it is produced and distributed and as to the measures which may be taken for its conservation.
>
> The deposits are limited to a few States, the consumption is nationwide. Competition and overexpansion have brought destructive price reductions, which have inevitably reacted upon labor standards with a resulting dislocation, restriction and obstruction of interstate commerce and a recurring danger of industrial strife. Circumstances such as these present the strongest possible illustration of how conditions of production directly affect commerce among the States.
>
> Admitting that mining coal, considered separately and apart from its distribution in the flow of interstate commerce, is an intrastate transaction, the constitutionality of the provisions based on the commerce clause of the Constitution depends upon the final conclusion as to whether production conditions directly affect, promote or obstruct interstate commerce in the commodity.
>
> Manifestly, no one is in a position to give assurance that the proposed act will withstand constitutional tests, for the simple fact that you can get not ten but a thousand differing legal opinions on the subject. But the situation is so urgent and the benefits of the legislation so evident that all doubts should be resolved in favor of the bill, leaving to the courts, in an orderly fashion, the ultimate question of constitutionality. A decision by the Supreme Court relative to this measure would be helpful as indicating, with increasing clarity, the constitutional limits within which this government must operate.
>
> The proposed bill has been carefully drafted by employers and employees working cooperatively. An opportunity should be given to the industry to attempt to work out some of its major problems. I hope your committee will not permit doubts as to constitutionality, however reasonable, to block the suggested legislation.

These developments, it was reported, failed to allay the subcommittee's doubts, however, and its struggles with the bill continued. Evidence that the members of the upper house were taking an interest in constitutional aspects was afforded by a resolution requiring the Attorney General to transmit a writen opinion to the Senate, offered by Senator Byrd on May 13. Then the bill ran into the tax program, with consequent threats of further delay.

Meanwhile, representatives of operators opposing the bill intensified their campaign against its passage. Following publication of the President's letter, H. R. Hawthorne, heading the Committee Against the Guffey Bill, reasserted the group's contentions that the bill was unconstitutional, would materially increase prices, would make it increasingly difficult to negotiate a new wage agreement and would work "irreparable damage" while its constitutionality was being decided upon. Issue with the contention that higher prices would result from passage of the bill was taken by Charles O'Neill, chairman of the legislative committee of the National Conference of Bituminous Coal Producers, in a letter addressed to the House subcommittee July 8. Producers favoring the bill total 287, representing 160,000,000 tons of the 1934 output of 358,000,000 tons, said Mr. O'Neill.

Mr. O'Neill's estimate of tonnage was sharply challenged by Mr. Hawthorne in a letter to the subcommittee on July 9. The roster of companies against the bill included 632 names after revision, he declared, with 777 additional companies reported in opposition. Production opposed totaled 215,515,466 tons, or 60.1 per cent of the 1934 total. Pro-Guffeyites, Mr. Hawthorne maintained, could muster no more than 85,000,000 tons.

H. R. Hawthorne
Leads Guffey-Snyder Opponents

Hearings on the revised Guffey-Snyder bill were resumed before the House Ways and Means subcommittee on June 25 with representatives of the Progressive Miners of America continuing objections offered by another independent labor organization —Independent Miners' Union of Western Kentucky, represented by R. M. Nance— at the previous sessions ended June 21 (July *Coal Age*, pp. 306-309). The bill, declared C. F. Keck, Progressive president, denies the right of collective bargaining to groups outside the "national organization" referred to in the proposed measure. In addition, operation of Title II would tend to eliminate "independent" operators and thereby increase unemployment. Mr. Keck's remarks were reiterated by George W. Dowell, chief counsel for the Progressives, who doubted whether $300,000,000 would be sufficient to buy up marginal properties.

Terming the theory of voluntary acceptance of the code provided in the bill as analogous "to the free surrender of one's purse at the point of a pistol," James A. Emery, general counsel, National Association of Manufacturers, declared that mining and shipment of coal is not affected with a public interest to the extent that it is subject to regulation by Congress. "The state of the law and the character of the problem suggests that the most constructive approach to the elimination of unfair and oppressive methods of competition and the maintenance of fair labor standards is through voluntary cooperation encouraged by sympathetic federal administrative action and under rational federal regulation." Sales agencies offer one means of such voluntary cooperation.

O. H. Wilcox, executive secretary, Employees' Mutual Benefit Association (employees of the West Kentucky Coal Co.), objected to what he termed an attempt to force the association to join a "national organization whose interests are north of the Ohio River and whose officers know nothing of our conditions and care less." Freight differentials must be considered in the establishment of wage rates and a uniform wage over the industry would eventually destroy the organization.

Bill Would Injure Coal

Expressing the opinion that the bill is unconstitutional and economically unsound, James D. Francis, president, Island Creek Coal Co., speaking for the committee opposing the bill at the opening of the June 26 sessions, declared that if the increased substitution of oil, gas and hydro power had not occurred, the 1934 production, on the basis of the 1914 participation in the energy market, would have been 500,000,000 tons, "the point being that but for the high delivery price of coal and the use of substitutes, coal would have stayed up above the average of 500,000,000 tons." Passage of the bill, Mr. Francis felt, would decrease his company's output, increase cost and reduce employee earnings. On the basis of current market prices, the bill would increase prices at Southern mines $1 per ton (40c. to get back to code levels and 60c. additional). In addition, attempts at correlation might result in an additional cost of 45 to 50c. to the consumer.

NRA, said Mr. Francis, was a benefit in spite of its imperfections, one of the major ones in relation to coal being the enforced correlation of prices, resulting in artificial price relationships which tended to break down the price structure. Similar but enhanced difficulties would be encountered under the proposed act, with the added complication of the introduction of cost of production as a factor to be considered in establishing minimums. As compared with the Guffey-Snyder bill, which he felt to be compulsory in spite of contentions to the contrary, NRA, in spite of imperfections and hardships on certain operations, "was a type of cooperation" that "might be permitted under the law as a permissive but not as a compulsory regulation." Congress could reasonably provide that where there are selling agencies such as ACI in the various producing regions they could agree, subject to the interests of the consumer and the veto of the government, to outlaw dumping in one another's districts. With this right, sales agencies should be able to obtain a yield comparable with that under NRA, pay reasonable wages and protect the industry against substitutes. Under the proposed bill, on the other hand, control would be

taken out of the hands of the industry, and one result would be inability to plan or make necessary investments in new equipment. Title II, Mr. Francis felt, was not only unsound but, even if it were feasible, did not provide sufficient funds to take enough properties off the market.

Appointment of a wholesaler or distributor on the proposed coal commission was requested by W. Clark Adams, Chicago Wholesale Coal Shippers' Association; James H. Galloway, representing Michigan wholesalers; and E. W. Brandenburger, St. Louis Wholesale Coal Association. Messrs. Galloway and Brandenburger also requested that the bill be amended to prescribe definitely the payment of reasonable commissions to wholesalers.

Revision of price-control provisions to remove unfairness to those districts and producers enjoying natural advantages and to extend to producers, under reasonable limitations and restrictions, the right to conduct their businesses as nearly as possible along normal lines was requested by Jonas Waffle, managing director, Coal Trade Association of Indiana. Stating that the operation of the bill would result in increases in prices in those districts enjoying a lower cost of production and short-haul advantages, with consequent reaction on sales, he offered four amendments to provide for: fixing of prices by each district on its own cost of production without relation to any other district; establishment by any district of minimum prices in any consuming area independently of any other district, subject to approval of the commission and the proviso that average mine-run realization be not less than average production cost of the district; granting of power to each district to revise price structure at any time to meet changing market conditions; and removal of all provisions requiring coordination of prices in consuming markets.

Kansas-Missouri Fear Increase

Approximately 700 Missouri-Kansas operators oppose the Guffey-Snyder bill because they feel it will increase their cost of production and thereby place them at a still greater disadvantage in comparison with oil and gas, said Grant Stauffer, president, Sinclair Coal Co. Enforced correlation, he declared, undoubtedly would parallel steps under NRA, which resulted in a damaging increase in at least one instance in markets served by operators which he represented. The bill also would be a burden on the smaller operator, who would be faced with the difficulty of lowering his prices to the same level as the larger operations. Sales agencies, on the whole, offer the best prospects for protecting the interests of the operator, miner and consumer, he concluded.

Railroad opposition to the bill was expressed by C. S. Duncan, economist, Association of American Railroads, on the grounds that carrier mines would be subject to its provisions and also to the taxes provided; the method of selecting the personnel of the commission does not sufficiently restrict the influence of the operator members; price-fixing provisions would tend to promote monopoly; provision for issuance of certificates of convenience and necessity for railroad extensions by coal commission is unwarranted transfer of power from I.C.C.; provision allowing commission to participate in proceedings before I.C.C. is unsound; and probable increase in coal prices would hurt industry and traffic. R. V. Fletcher, general counsel, presented the association's contention that provisions relating to certificates of convenience and necessity be eliminated.

Opening the June 27 sessions, Daniel T. Buckley, American Wholesale Coal Association, reiterated the contention of previous witnesses that the proposed coal commission should include a wholesaler representative in order to assure distributors a fair break in commissions.

While Alabama operators are willing to participate in any constructive measures for the aid of the industry, they feel it impossible, in view of the competition of substitute fuels, to support the increased prices they feel would result from the adoption of the bill, said Forney A. Johnston. Furthermore, marketing and labor conditions in Alabama and the country at large do not warrant the drastic measures included in the bill, which might make it impossible for the industry to go ahead with its own stabilization program along the paths marked out by the ACI decision and the work of the Federal Trade Commission, with the additional assistance of some slight modification of the federal statutes. In addition to these factors, many of the provisions of the bill, according to Mr. Johnston, are of doubtful legality.

Charles O'Neill
Generalissimo of Pro-Guffeyites

Appearing for the Alabama Mining Institute, H. T. DeBardeleben, president, DeBardeleben Coal Corporation, declared that the industry control proposed in the bill would "render the industry incapable of competing in any fair measure with laborless fuels, such as natural gas and oil, or with other sources of heat and energy, such as hydro-electricity." This is an especially severe problem to the Alabama industry, and Mr. DeBardeleben deprecated the "premature" attempt to impose an arbitrary code on the industry by statute without corresponding treatment of competitive fuels.

Charging that the state of overdevelopment in the bituminous industry has been exaggerated, E. H. Suender, consulting engineer, Consolidation Coal Co., declared that his company opposed the bill on the grounds of unconstitutionality, unenforceability from the practical standpoint, possibility of increased prices and restriction of the industry's program of combating substitutes, unfair labor provisions, and discrimination against smaller producers.

Stating that he was on the fence, C. H. Mead, president, Mead Smokeless Coal Co., declared that he favored purchase of marginal properties by the government and exemption of captive mines to prevent a reaction which might injure commercial operations and opposed marketing agencies on the ground that they would tend to promote monopoly. He opposed labor provisions on the ground that they would give too much power to the union, and made the following recommendations: reconstitution of the proposed coal commission to include one operator from either the North or the South, one miner from the opposite region, as the case might be, one representative of industrial coal buyers, one distributor and five disinterested persons; consideration of the claims of wholesalers; and reduction of district operator boards to the smallest possible personnel to promote impartiality.

Opening the final sessions on June 28, Victor S. Gauthier, International Association of Machinists, offered a number of amendments designed to insure that the majority of any class or craft of employees not part of majority of workers employed by operators shall have the right to determine who shall be the representatives for collective bargaining purposes. His organization, said Mr. Gauthier, favors the bill.

Price-Fixing Plan Discriminatory

Price-fixing provisions of the bill were singled out for attack by L. G. Caldwell, representing the Northern Illinois Coal Corporation, on the ground that consumers in markets close to producing districts would be forced to pay more for coal from these districts in an attempt to counteract the difference in freight rates, thus nullifying the advantage of mines in those districts and causing them losses in business. The witness offered the following recommendations in behalf of the company: elimination of provisions for coordination of prices; elimination of transportation costs as a factor in fixing prices in districts; inclusion of a provision that no price shall be effective in a producing field without the approval of a representative from the field; and adoption of a rule that oil and gas competition be taken into account. No objection was made by the company to the labor provisions.

Providing present wage rates are continued, price provisions of the bill, in spite of the contentions of its opponents, will not increase prices over the NRA levels, declared H. L. Findlay, vice-president, Youghiogheny & Ohio Coal Co., and member of the special legislative committee of the National Conference of Bituminous Coal Operators, which was largely responsible for the drafting of the price provisions. In fact, said Mr. Findlay, it is possible that prices may be reduced somewhat. The major difference compared with code price provisions is that effective means of enforcement have been added. The contention that each district will have to get the average production cost for the minimum price area is not correct. The idea, on the contrary, is that while some districts will be under, others will be over, so that

the average realization for the price area should equal average cost. While expressing friendliness to the sales agency idea, Mr. Findlay felt that it will not live up to the claims of its proponents, as difficulties already have been encountered as a result of pressure of excess productive capacity, with attendant effect on prices.

"To declare that an industry is impressed with sufficient public interest to regulate it merely because it has labor troubles and its units are too small and too numerous for coordinated and efficient management is stretching the idea a long way," declared Charles G. Berwind, vice-president, Berwind-White Coal Mining Co., who envisaged the bill, if upheld, as the opening wedge for eventual government ownership of all businesses. The measure may result in a brief period of false stability, but in the long run will be disastrous to operator, miner and consumer. It does not protect the public from the results of labor disputes, will increase prices, provides for the establishment of a commission and labor boards whose personnel is not conducive to concerted effort to the common good, and, under Title II, offers the possibility of increased taxes on coal and eventual government ownership of the resources of the nation.

The failure of management to protect either its own interests or that of its employees, as evidenced by the accident record of the industry, past relations with labor and inability to resist influences tending to reduce prices to unreasonably low levels, is a major reason for the passage of federal legislation, contended John L. Lewis, president, United Mine Workers, in a lengthy statement. While operation of the bill might increase prices to some extent, the rise in terms of proportion of the cost of manufactured articles would be relatively small, and the consumer would, Mr. Lewis felt, cheerfully pay the difference if it would assure elimination of human misery, poverty and death. The bill would not hurt the small producer and would not penalize any particular producing area, and Title II would be a definite benefit if it removed inefficient high-cost operations from the producing roll.

Closing the hearings, sharp exception was taken by Mr. Mead to Mr. Lewis' contention that management has failed to discharge its responsibilities properly, as well as to other charges against the operators by Mr. Lewis.

How Wire Rope Is Made

An exhibit showing how wire rope is made, including models of rope-making machinery, recently installed in the Museum of Science and Industry, Jackson Park, Chicago, has elicited widespread interest. The exhibit demonstrates with simple equipment how wire is drawn, woven into the strand, and then twisted into finished cable. Photographic panels illustrate various steps in the process of manufacture. The exhibit was donated by the Macwhyte Co., Kenosha, Wis.

Domestic Pulverized Coal

Invention of a fully automatic pulverized-coal heating unit for domestic purposes was announced last month by Aubrey J. Grindle, Chicago, an authority on the use of pulverized coal. The unit, it is stated, can be applied in any home heating plant and will result in savings of 50 to 75 per cent. A special igniter lights the fuel automatically when the thermostat calls for heat. There is no pilot light and the unit is dead when the desired temperature is attained.

New Alabama Mines Building To Be Erected Soon

A contract for a new Bureau of Mines Building to be erected at Tuscaloosa, Ala., near the University of Alabama campus, is ready to be let, a bid of $87,989 having been accepted. An award awaits approval by Washington authorities before construction can be started.

Included in the equipment will be a Jeffrey-Baum laboratory-size jig which will be used to conduct practical washing tests in connection with coal analysis. It has all the features of the commercial size except that the speed of the refuse ejector mechanism is controlled manually instead of by automatic float control. All the main function details of the jig are adjustable. Incorporated in the design is a horizontal U-shaped water column with replaceable sections of various lengths so that the hydraulic effect of water column may be ascertained in the experiments. The speed of the jig—that is, the number of strokes per minute—can be varied, as can the length and type of stroke, through regular double air valve.

Industrial Notes

JOHN G. BARRY, senior vice-president, General Electric Co., has retired from that office after more than 45 years' service with the company and has been elected an honorary vice-president. He will maintain an office at the Schenectady (N. Y.) plant, where he will be available for consultation.

E. J. MCDONNELL has been appointed vice-president of the industrial division of Blaw-Knox Co., Blawnox, Pa. L. A. PRESCOTT has been made vice-president of the company's engineering division.

MACWHYTE CO., manufacturer of wire rope, has moved its Chicago branch offices and warehouse to the newly remodeled Macwhyte Building, 228 South Des Plaines St.

THEODORE H. ROSS has been appointed Pittsburgh (Pa.) district sales manager of the Industrial Stoker Division of Combustion Engineering Co., Inc., New York City.

JAMES T. SUTLIFF, who for many years was connected with the factory of the Roots-Connersville Blower Corporation, at Connersville, Ind., is now associated with the Chicago office of the company, where he will specialize on sales of turbine pumps and blowers.

JOHN THIES, formerly in charge of sales in the Birmingham (Ala.) district for the Portable Lamp & Equipment Co., Pittsburgh, Pa., has been transferred to Terre Haute, Ind., and placed in charge of territory covering Indiana, Illinois and Kentucky.

JAMES J. ZIMMERMAN has resigned his connection as statistician for the Eastern Bituminous Coal Association and joined the organization of the Osborn Machine Co., DuBois, Pa. He was formerly production manager for the Elliott Co. and assistant general superintendent of the Scott foundry department of the Reading Iron Co.

Death Rate Slightly Higher

Coal-mine accidents caused the deaths of 66 bituminous and 28 anthracite miners in May, according to reports furnished the U. S. Bureau of Mines by State mine inspectors. This compares with 54 bituminous and 18 anthracite fatalities in the preceding month and 73 bituminous and 26 anthracite deaths in May, 1934. With a production of 26,790,000 tons, the bituminous death rate in May was 2.46 per million tons, the same as in the preceding month, when 21,920,000 tons was mined, compared with 2.67 in May, 1934, in mining 27,385,000 tons. The anthracite fatality rate was 5.68 per million tons in May, based on an output of 4,930,000 tons. In the preceding month the rate was 3.75 on an output of 4,806,000 tons, and in May, 1934, it was 4.95 in producing 5,250,000 tons. For the two industries combined, the death rate in May was 2.96, against 2.69 in the preceding month and 3.03 in May, 1934.

Comparative fatality rates in the first five months of 1934 and 1935, by causes, are given in the following table:

FATALITIES AND DEATH RATES AT UNITED STATES COAL MINES, BY CAUSES*

	Bituminous		Anthracite		Total	
	Number Killed	Killed per Million Tons	Number Killed	Killed per Million Tons	Number Killed	Killed per Million Tons
January-May, 1934						
Falls of roof and coal	215	1.374	69	2.414	284	1.535
Haulage	62	.396	15	.525	77	.416
Gas or dust explosions:						
Local explosions	5	.032	10	.350	15	.081
Major explosions	...	...	...	...	...	...
Explosives	13	.083	6	.210	19	.103
Electricity	15	.096	3	.105	18	.097
Machinery	6	.038	2	.070	8	.043
Surface and miscellaneous	52	.333	28	.979	80	.433
Total	368	2.352	133	4.653	501	2.708
January-May, 1935						
Falls of roof and coal	201	1.268	61	2.651	262	1.443
Haulage	85	.536	12	.521	97	.534
Gas or dust explosions:						
Local explosions	7	.044	5	.217	12	.066
Major explosions	...	...	13	.565	13	.072
Explosives	15	.095	8	.348	23	.127
Electricity	10	.063	...	...	10	.055
Machinery	10	.063	...	...	10	.055
Surface and miscellaneous	35	.221	30	1.303	65	.358
Total	363	2.290	129	5.605	492	2.710

*All figures are subject to revision.

WHAT'S NEW

In Coal-Mining Equipment

EXCAVATORS

Link-Belt Co., Chicago, is now offering two new models of crawler-mounted, shovel-crane-draglines bearing the designations K-40 and K-45. These machines, it is announced, replace two discontinued models, to which they are substantially similar with additional features for facilitating and maintaining operation, decreasing maintenance and increasing performance and life. The two new models,

like others in the company's line, are built for heavy-duty service, it is pointed out, and are arranged for gasoline, diesel or electric drive. They also may be furnished with any or all of the attachments usually available only on smaller machines or machines of limited characteristics, the company states. Additional features include: adaptability to shipping the complete machine on a flat car without dismantling; improved two-tread steering arrangement; and centralized lubricating arrangement on the rotating frame.

As shovels, standard equipment on both models includes a 22-ft. boom, 16½-ft. dipper stick, and 1¼- or 1½-cu.yd. dipper on the K-40 and K-45 machines, respectively. As a dragline, the K-40 unit will handle a 1¼- to 1½-cu.yd. bucket and the K-45 a 1½- to 1¾-cu.yd. bucket. As a crane, the K-40 machine has a rated capacity of 21 tons at a radius of 12 ft. and 6,000 lb. at a 45-ft. radius with a 45-ft. boom. With the same boom, rating of the K-45 machine is 25 tons at 12 ft. and 7,600 lb. at 45 ft. For normal digging depth in average soils, the standard bucket on the K-40 unit when used as a trench hoe is 1½ cu.yd.; K-45, 1¾ cu.yd., a solid-bottom bucket being used in either case. When used as a shovel or dragline, correspondingly larger buckets than those mentioned can be used in lighter service.

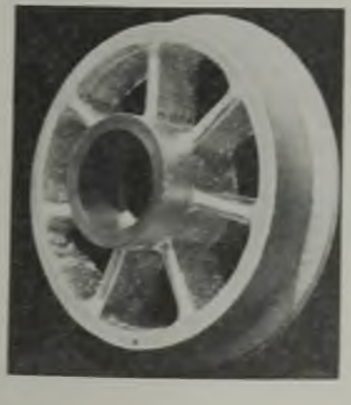
WEDGE WIRE

Abbe Engineering Co., New York, announces that it is prepared to offer temporarily a wedge-wire screen section of brass, phosphor-bronze or manganese-bronze with either 18/8 or "USS17" stainless-steel crossbars without extra cost. Use of these stainless steels for crossbars for brass or bronze sieves, the company states, increases rigidity and in connection with its patented spacing lugs prevents mesh enlargement, both increasing the useful life of the screens.

CASTING METAL

Mine-car wheels and a variety of castings for mine service are offered by the Kanawha Mfg. Co., Charleston, W. Va., in "Meehanite" metal—stated to be a fine-grained, tough, wear-resistant material between cast iron and steel. The manufacture of Meehanite, it is pointed out, is controlled so that predetermined physical properties are consistently obtained, and the metal in the test bar is guaranteed to satisfy definitely specified characteristics and is sold on that basis. Any size casting can be made without developing cracks, draws, blowholes or strains, it is asserted. Also, unusually close tolerances are practicable in either large or small castings, and the metal machines freely and is free from white edges and hard spots. Service qualities, it is stated, are controlled to meet specific requirements, such as combined strength and toughness, corrosion and acid resistance, abrasion and erosion, pressure tightness, exceptional resistance to shock and strain, and intense hardness—by chilling or heat-treatment.

Meehanite Mine Car Wheel

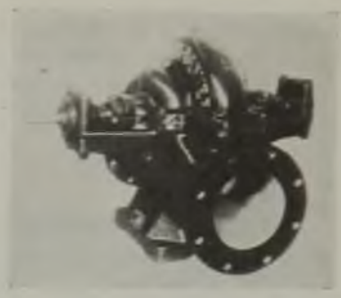


VIBRATOR

Allis-Chalmers Mfg. Co., Milwaukee, Wis., offers a new exceptionally sturdy low-priced single-deck screen of the "Aero-Vibe" design in all sizes from 1½x3 to 5x10 ft. for medium- to fine-sized materials, either wet or dry, in moderate tonnages. These screens are suspended by cables and springs and are vibrated by adjustable counterweighted wheels.

CENTRIFUGAL PUMPS

New lines of side-suction and double-suction centrifugal pumps are announced by the Gardner-Denver Co., Quincy, Ill. Low first and installation costs are claimed for the side-suction units, in addition to higher efficiency through design details, including impeller-blade angles and wear channels. In addition to smoothness by a special foundry process, machining of impellers is held to a minimum to preserve the normal hard outer skin of cast iron and thus increase resistance to abrasive wear. Compactness and simplicity also are stressed by the company, which notes that the shaft, impeller and bearing are the only moving parts. An adjustable thrust bearing for taking up wear between impeller and casing and exceptional sturdiness are other features.



Available in Types B and C, these pumps will handle up to 450 g.p.m. at heads up to 100 ft.

The double-suction pumps, available in the D, E, F and G series (identical except in dimensions) for graduated heads up to a maximum of 300 ft., are of the single-stage split-casing types. Design details, it is stated, insure easy maintenance, give higher efficiency and make operation easier. The pumps are designed for any type of drive (including flat or V-belts, direct-connected, gas or diesel engine), although the usual drive is based on direct connection to an electric motor.

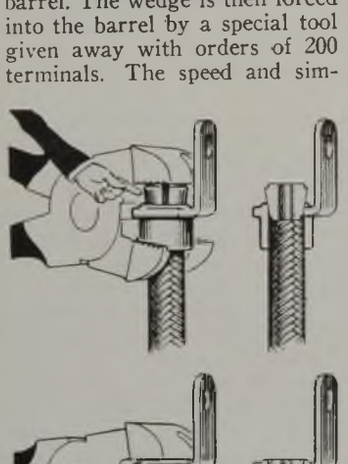
AIR VELOCITY METER

Illinois Testing Laboratories, Inc., have developed the shutter-type Boyle "Velometer," a direct-reading air velocity meter said to give accurate and instantaneous readings of the speed and direction of air motion in feet per minute. Standard scale range is 0 to 300 and 0 to 3,000 f.p.m., although other scales are available. Low scale is said to provide accurate readings as low as 20 f.p.m.; the high, accurate readings to the limit of the scale. A pointer-

locking button is provided to lock the pointer to preserve a reading or when the instrument is not in use. Size is 5¼x5¼x2⅜ in. Weight is 2 lb.

CONDUCTOR TERMINAL

Thomas & Betts Co., Elizabeth, N. J., has developed a new mechanical lug for wires ranging in size from No. 22 to No. 4, which it designates as the "Wedge-On" conductor terminal. In applying this terminal, just enough insulation is cut away so that when the cable is introduced in the lug the bare wire reaches the whole length of the tapered wedge and the insulation is supported by the barrel. The wedge is then forced into the barrel by a special tool given away with orders of 200 terminals. The speed and simplicity of the operation, according to the company, reduces costs. Also, it is pointed out, use of these terminals eliminates the objectionable features of soldering.



HICH-HEAD PUMP

Byron Jackson Co., Berkeley, Calif., offers a specially designed pump for extremely high lifts or high pressure, designated as the "Hydropress." The pump is said to embody the principle of the centrifugal types and permits pressure up to 2,800 lb. per square inch. Stages range from 4 to 54, depending upon conditions; capacities, from 10 to 250 g.p.m.; sizes, 8, 10, 12 and 15 in.

AIR NOZZLES

Lunkenheimer Co., Cincinnati, Ohio, offers two air nozzles for blowing dirt, dust, chips, filings, borings, sand, lint, liquid deposits and other matter. One feature is renewable

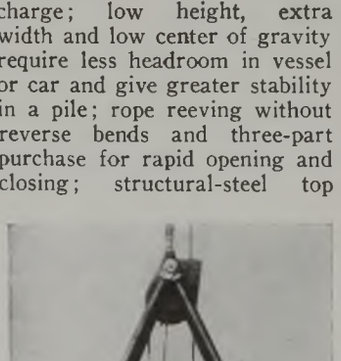
non-metallic disks. One type is made with integral hose end and the other with female pipe end. Either pattern can be furnished with pointed, flat or extension tip.

CONVERTIBLE MOTORS

A new line of convertible squirrel-cage and slip-ring induction motors offering all standard frequencies for 110- to 220-volt service has been announced by the Harnischfeger Corporation, Milwaukee, Wis. Built in accordance with NEMA standards, these P&H motors are said to feature ready convertibility from the open type to fan-cooled, splashproof or totally inclosed construction, which is accomplished by frame, end-head and bearing design to permit interchangeability.

GRAB BUCKET

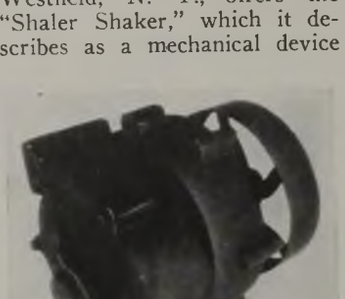
Mead - Morrison Division, Robins Conveying Belt Co., New York City, offers a new light rehandling grab bucket (Type RH), for which it notes the following features: exceptionally high capacity compared to weight; special shells intermediate in shape between flat and round, giving advantages of the former shape in digging and filling and the latter in discharge; low height, extra width and low center of gravity require less headroom in vessel or car and give greater stability in a pile; rope reeving without reverse bends and three-part purchase for rapid opening and closing; structural-steel top



heading with manganese-steel fairleader bolted in; single- and double-ear cast-steel hinges with large high-pressure lubricated bearings; links of large-diameter steel tubing welded to the cast-steel ends, giving greater strength with less weight and providing rounded corners with consequent decrease in damage to barges and cars.

SHAKER

Ajax Flexible Coupling Co., Westfield, N. Y., offers the "Shaler Shaker," which it describes as a mechanical device



for replacing the common eccentric drive in imparting a horizontal shaking or screening motion to a sieve, conveyor or other equipment demanding such motion. Mechanically, it consists of two weights geared together so that when one is driven both rotate at the same speed but in opposite directions. Features noted by the company include: proof against dust, oil and fire; over 95 per cent of rotative weight effective; segmental weights operate in dustproof inclosure, eliminating concentrations of dust and grease opposite weights which would reduce effectiveness; belt or direct drive; adaptability to operation of two or more units in parallel; and positive lubrication by the splash system.

PLUG-TYPE VALVE

Fairbanks Co., New York City, offers a new plug-type valve for service where there is excessive wire drawing or destructive action of any kind on the valve seat or disk, such as in drip, drain, throttling, etc., service. Features noted by the company include: long seating surface between plug and seat for long life; ready regrinding or renewal of these surfaces after scoring or cutting; uniform distribution of steam flow and elimination of concentration on any part of the plug or seat with consequent erosion or wire drawing; seat ring screwed into diaphragm for easy renewal; seat and disk of high Brinell nickel alloy which can be reground indefinitely without removing the valve from the line; and adaptability to packing stuffing box under pressure while the valve is wide open.

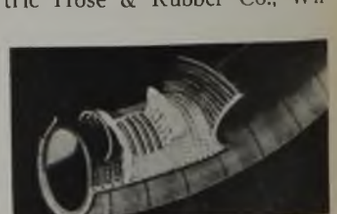
FLEXIBLE COUPLING

The new Type "P" L-R flexible coupling for shaft diameters from 3 to 10 in. is offered by the Lovejoy Tool Works, Chicago. The couplings, according to the company, have individual free-floating load cushions hung between jaws on removable studs. Cushion material is either "Metalflex," a high-grade long-wearing brake-lining material for heavy shock loads and exposure to extreme weather variations; leather for sustained loads and greater misalignment; or "Multiflex," a rubber-duck fabric vulcanized under pressure for use on fluctuating loads and where high resilience is required.

Load cushions, it is pointed out, are in plain sight at all times and can be replaced in a few minutes. Elimination of wear on iron or steel jaws is said to make the coupling practically everlasting. No lubrication is required. One-half the cushions are always idlers except in reversing, and interchangeability eliminates shutdowns. By application of suitable materials and modifications of design, says the company, capacities can be increased to 250 per cent of ratings without change in over-all dimensions.

SUCTION HOSE

Lightness and easy handling are among the advantages claimed for the "Delmar" suction hose developed by the Electric Hose & Rubber Co., Wil-



mington, Del. Construction is based on the use of a woven tubular reinforcement of strong cabled cotton cords, said to make the hose light and yet prevent collapsing. A smooth lining of specially compounded rubber for long life and minimum frictional resistance also is pointed out by the company, in addition to easy restoration to shape by use of a vise and mallet after crushing. It is adapted to connection to standard couplings, and is made in all sizes up to 4-in. inside diameter.