

SUPPLY HAULAGE IN TRACKLESS MINING

By ROBERT FLETCHER

Mr. Fletcher, Consulting Engineer, J. H. Fletcher Co., Chicago, Ill., describes methods of supply distribution in mines with shuttles for gathering or belts for panel and main haulage, using track paralleling the belt or rubber tired trucks for man-trips and material.



SUPPLY haulage is the problem of transporting material into and about the mine, and distributing it with a minimum of interference with the flow of coal.

Where trackless gathering is employed, i.e., shaking conveyor, chain conveyor, or rubber tired unit discharging directly into mainline mine cars, there is usually a rehandle of material between the mine car and the gathering equipment. Frequently the supplies are stock piled at the room neck or the central loading point and distributed from there by reversal of the gathering equipment.

However, with the addition of panel or butt entry belts, or in complete mainline belt conveyor systems, the supply haulage becomes critical, for these units should not be reversed during the working shift. When they are reversed to handle supplies on the off-shift, the labor for handling supplies is in direct ratio to the points of rehandling, and there is the ever present danger of damage to the belt.

In a belt operation the term supply haulage also includes movement of men along the conveyor line, both general

labor between each shift, and supervisory or maintenance men during each shift.

Supply Distribution from Room Neck to Face

Figure (1) is a schematic drawing of trackless gathering equipment discharging to mine cars on the panel or butt entry. Supplies loaded into the mine car at the supply yard are brought by rail to the room neck, or, where a mother chain or five-room rubber tired system is employed, to the central loading point. From there the method depends on the type of gathering equipment. But in any case, stock piling of supplies in the room neck causes congestion, especially in the low seams and therefore, daily distribution of pans, chains, and other material is advantageous.

Shaking conveyor systems may distribute supplies from the room neck to the working face by dolly cars pushed manually inside the pan line. Another method is known variously as the "dead-pan," "double-pan," or "false-pan line." Spare pans are coupled parallel to the active pan line. When it is necessary

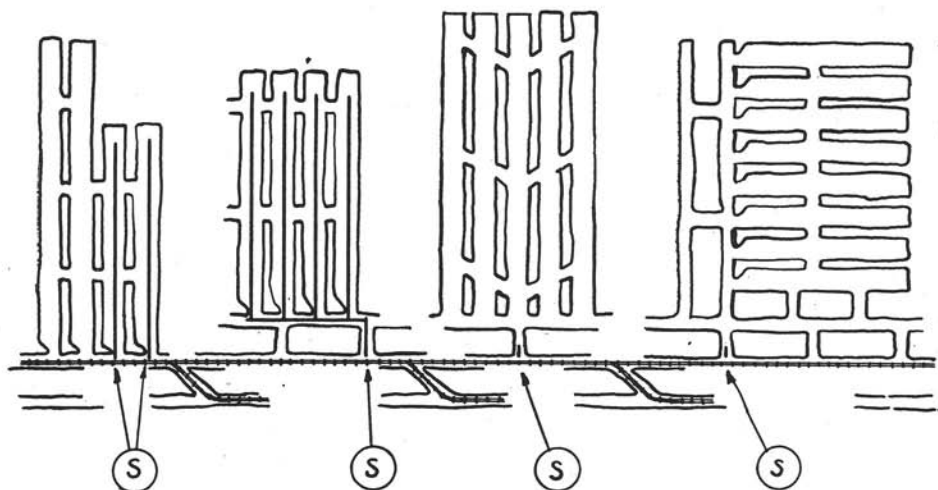


Fig. 1. Location of stock piles (S) in working sections

to add another pan to reach the fall with the loading head, the winch on the machine is used to draw up the dead-pan line. In each pan are the props, wedges, and other supplies required in mining the length of the pan. Having been drawn ahead, there is space at the room neck to attach another pan to the deadline, into which is put the supplies from the storage pile. It is sometimes found difficult to keep these pans lined, and in close timbering it is not possible to draw enough supplies to the face in this manner.

There are installations of chain and shaker conveyors where light rail has been run next to the pan line to carry a supply car. In some operations, push carts are drawn on the bottom and a small cable reel unit has been developed which will haul supplies the length of the room.

There has been some discussion of using a double drum winch, held at the room neck by roof jacks and spooling a light cable which threads through a sheave mounted on a jack pipe carried along as the face advances. One drum would wind 600 ft. of cable, the other drum would be split to handle 300 ft. of

cable and 300 ft. of control line. The cable would draw a skid sliding on the bottom with space for a man to ride and drag materials. As the operator travelled to the face on the skid he would carry the control with him, so as to start and stop the skid at will.

These same methods are more or less adapted to chain conveyor work, though reversing the chains is most usual. Height permitting, in some of the closely timbered mines, ponies are worked, because of their maneuverability.

In rubber tired gathering the coal carrying unit can be used to distribute supplies. Either a few props may be picked up from the supply pile by a shuttle car operator during a halt in the loading operation, or a supply man may use a spare car to distribute bits, etc. While this may be successful where supplies are at a minimum, in the closely timbered and heavily crossbarred mines the large volume and weight of timbers accentuates the supply problem.

Time study made by a West Virginia coal company where the average crossbar is 6 in. by 8 in. by 14 ft. and the post 6 in. round by 7 ft. showed that the cost of removing bars from the mine to the

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stock pile in the working territory averaged 2.2 cents per bar, and props 1 cent apiece. The timbering crew required anywhere from 11 per cent to 23 per cent of the working time in picking up these supplies from the stock pile and moving them to the face. It was also noted that weight of the bars was more than could be handled by the regular timber crew. This meant that men from another operation had to leave their work and help the timbering crew with the bars.

Panel or Butt Entry Belt Conveyors

If the gathering equipment discharges to panel belt (Figure 2), thence to rail haul, another unit is placed in the way of supply distribution. Here not only re-handling becomes a problem, but timing as well. Face gathering equipment has periods throughout the day when the loading of coal is halted as other mining operations are performed. Taking advantage of these slack times, supplies can be moved by the equipment. Most

panel belt conveyors, however, are loaded by more than one working unit, and must run continuously and it is, therefore, the practice to bring in supplies on the off-shift. Double shift mines can employ a third shift supply crew, but there are difficulties in obtaining third-shift labor, and maintaining supervision. A triple shift mine is forced to sacrifice part of the working time for handling supplies, thus cutting into coal production.

In off-shift supply handling, the belt conveyors are reversed, usually at half speed. Idlers cut to train the loaded belt now react to draw the belt out of line. This may result in edge wear, especially on the return run, where most damage to the side of the belt occurs. Generally the supplies are loaded onto the belt piece by piece, and as men must be stationed at each point of distribution, considerable labor is involved. Occasionally a capboard eludes an unloader and goes through the tail hopper. In this manner belts are bruised and eventually carcass breaks result.

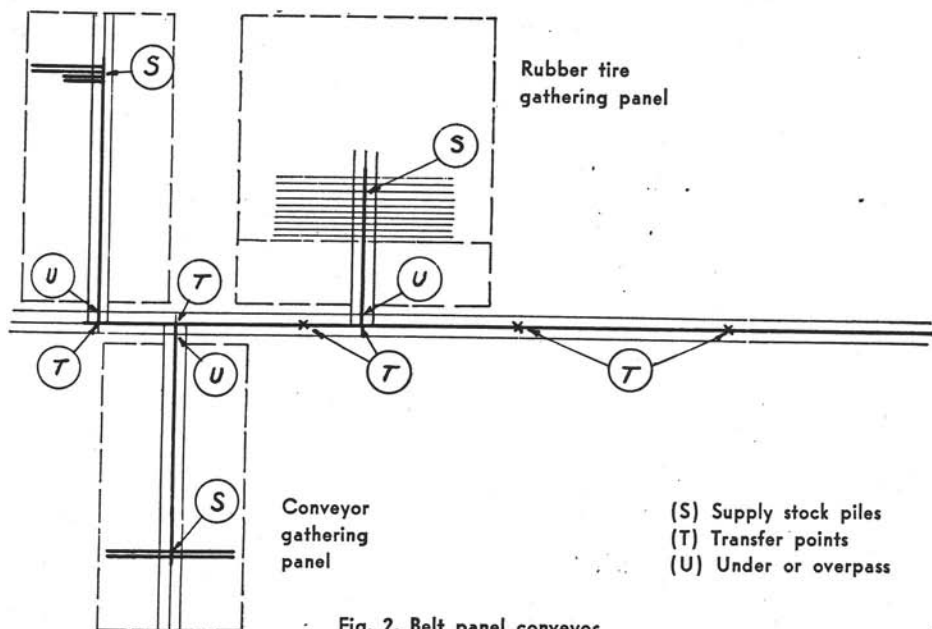


Fig. 2. Belt panel conveyor

Where panel belts discharge to other sections of belt, the extreme example being an all-belt mainline, the rehandling is multiplied. It is the tendency in the use of long belts to establish a supply route so that men and material may move independent of the flow of coal. Where height is such that bottom need not be taken, some mines have paralleled the belt line with light rail track. Others run mobile supply trucks over well kept haulage ways.

Tractors and Trailers

The pneumatic tired equipment is battery powered and either of the truck or trailer type. In high seams a large load can be transported on a truck; however, as seam height decreases, carrying capacity becomes limited. By using a tractor, capable of drawing a number of trailers in a train, the carrying capacity is maintained by distributing the load over a greater length. There is also the possibility, where haulage is a combination of belt and rail, of transporting the trailers to the outside on flat rail cars, where they are loaded in the supply yard, returned to the belt head, and pulled from the car by the tractor.

This means that a single supply man can transport a full bulk load from the outside of the mine to the face. Rehandling is eliminated at the belt rail junction because proper equipment is provided to handle the bulk load as a unit. Belts need not be reversed since the load is pneumatic tired mounted and travels a haulage way paralleling the belt. Finally, distribution is not done by face equipment.

Depending on haulage conditions and trailer loads, a number of trailers may be coupled together in a trip and drawn the length of the belt line. As the working territory is reached a trailer may be dropped from the trip and left ready for a section supply man to pick up and distribute, while the balance of the trailer train may go on without delay.

The tractor-trailer supply system is used at a West Virginia mine drifting into the Sewell seam with height varying between 30 in. and 40 in. where rubber tired gathering brings the coal to 30-in. panel and 36-in. mainline belt conveyors. Supplies are loaded on the outside into trailers having two pneumatic carrying wheels and a pneumatic caster under the tongue, giving three-point support. Seam height limits each trailer capacity to approximately two tons, therefore, a number are drawn in a train. Power is by battery tractor acting in a similar manner to a mine motor.

A haulage way is maintained adjacent to the belt line, and where it is necessary, overpasses are provided. These consist of a ramp that is built up to either side of the conveyor that is to be crossed and removable runways for the wheels bridge over the belt.

Upon reaching the parting the tractor disconnects from all but one trailer. The tractor operator draws this trailer of supplies to the face, distributing them as required; the empty trailer is then recoupled, and the train moves on. A single tractor-trailer unit can back as readily as move forward.

Where supplies are to be moved by pneumatic tire equipment over a mine haulage way, the success of the operation is proportional to the maintenance of the roadbed. Drawbar pull is dependent on tractive effort between the drive wheels and the road, consequently the better the road conditions, the higher the tractive effort and the more load the tractor can pull. Likewise, the road resistance of the trailing load decreases as conditions improve.

Chart No. 1 shows estimating data for determining loads that can be handled over various road conditions. From a study of this chart it is evident that a maximum tractive effort and minimum rolling friction are the result of good road conditions. This reflects directly on the power demand on the storage bat-

CHART I—TRACTIVE EFFORT FOR RUBBER TIRES

Road resistance	
(Rolling friction):	
Average good road.....	50 lb./ton
Loose roadbed.....	80 lb./ton
Clay or sand.....	200-300 lb./ton
Grade resistance:	
20 lb./ton for each per cent of grade.	
Tractive effort:	
Road resistance plus grade resistance.	
Maximum tractive effort:	
(Drawbar pull)	
67% load on drive tires.	

tery, and the maintenance cost of the equipment. There is no more important point in the supply system than maintenance of a first class haulage road.

At another West Virginia slope mine gathering is by shaking conveyor to panel and mainline belt. Supplies are to be handled by trailers loaded in the supply yard and dropped down the slope by cable. The rubber tires will run in a sort of a track, using channels with flanges turned up; at the bottom they will be coupled into trips and drawn to the shaking drive heads.

Many Uses for Tractor Trailer

Here the tractors will be expected to haul men, supplies, move up of face equipment, and handle specialized units such as fire fighting equipment mounted on a trailer chassis and stationed where it can be picked up by a tractor and drawn to a point of need. The trailers are designed to fit the seam dimensions of width and height. Length is governed by the materials to be handled, in this instance, twice the length of the standard prop.

The tractor is also useful in carrying supervisory or maintenance men about the mine; in this case it does not draw a trailer unless a load is to be handled. There is space on the tractor for transporting small supplies.

An Eastern Kentucky mine will use

the tractor-trailer supply system in conjunction with timbering machines. With the problem of long crossbars it was found that as the trailer length increased, they cut the corner if more than one was drawn at a time. To overcome this, a steering trailer has been developed which automatically follows about the corner, having action similar to 4-wheel steer. Handling 14 ft. to 18 ft. bars, a tractor pulling two trailers will negotiate a 12 ft. entry off a 12 ft. entry. The wheels steer while trailing, but when operating as a single unit the wheels are locked in a neutral position.

The trailers will be drawn from the belt head to the working territory where they will be left for the timbering machine to pick up. It is expected that two trailer loads of props and crossbars will be used by each timbering machine crew per shift. The trailers are to be loaded with a definite number of bars, props, and cap boards. If all are not used, or a few bars or props remain, they will be left on the trailer to be picked up by the tractor and returned for reloading. No attempt will be made by the timbering crew to shift materials from one trailer to another.

Special trailers carrying spare batteries for the face equipment are also to be drawn to the working territory from the battery room built at the belt head. This permits a central charging station.

A Western Kentucky mine in the 42 in. No. 6 seam operates shaking conveyors discharging to belts, with main line rail haul. Supplies will be handled by tractor-trailer from the belt-rail junction to the room neck. Mining is advancing on one side of the panel and retreating back on the other, a haulage way being maintained on the off side of the belt from the shaking units. Supplies are to be passed across the belt at the room neck.

With the establishment of a supply system paralleling the belt line, it may be found that some changes in the min-

ing conditions will improve distribution, such as, in the low seams, mining on one side of the belt, leaving the other open for supply haulage. Where belt lines must be crossed, seam characteristics will determine whether to use an underpass or overpass. Occasional dragging of roadways, sumping if wet, applying calcium chloride if dry will be found advantageous.

The supply problem is individual to

each mine because of varying seam conditions and mining machinery. Assuming the use of equipment adapted to the supply operation, special consideration should be given to points of rehandle from one transportation unit to another. Transfer should be in bulk loads. Then with the establishment of a separate haulage route flexibility of distribution is obtained, and the supply problem is well on its way to a solution.

—Discussion—

J. W. Brauns (*General Electric Company*): When I was requested to comment on Mr. Fletcher's paper, I was apprehensive of anyone being able to clearly discuss a subject so new in this modern day mechanization period. However, I feel sure you will all agree that Mr. Fletcher has presented an outstanding discussion of a problem which must be solved and solved quickly if the advantages of mechanization are to be fully realized. The data in this paper should start a good discussion of your individual supply haulage problem in trackless mining. The speaker stated that the problem is individual to each mine and hence recognizes that his paper does not cover all the means to help solve the supply haulage problem in trackless mining.

To my mind, the subject "Supply Haulage in Trackless Mining" confines the discussion to a very small percentage of the mines without tracks and/or that part of the mine without tracks, but the subject should be treated more broadly and should cover the supply haulage problem starting at the entrance to the mine or at the supply point above ground. Thus, all costs for moving the supplies from the warehouse to their ultimate destination are considered and the problem is then to obtain the minimum over-all cost of moving the supplies.

The plan of rubber tired haulage on entry roads parallel to a main haulage-way is a solution in those mines where the distance from the entrance is relatively short, let us say up to 3,000 or 4,000 ft. I say this because now the vast majority of large production mines now have a main line haulage distance as high as 5 to 7½ miles. On these haulage-ways are installed a railroad on which the cars and locomotives can travel. It seems to me that since such a road exists that it is only natural to use the rails to send the supplies into the mine in the pit cars as far as the rail may go. Beyond that point, it is obvious that the material must be moved on the existing conveyors, shuttle cars, or other portable means such as rubber tired tractor and trailer system which Mr. Fletcher has so ably described.

At the end of the rail line we have a transfer involved and maybe several transfers will be involved before the supplies reach their ultimate destination. These transfers involve both labor and possibly special material handling equipment. With rising labor costs and probably difficult material handling equipment problems at these transfers, it is again natural that some new or novel method and equipment should be devised with the idea of eliminating as many transfer points as possible. For this, I

would suggest the possible use of a rubber tired vehicle with steel flanged pilot wheels to haul the supplies over the rails and then merely raise the pilot wheels and proceed under its own power over a roadway to the supply's ultimate destination. Another scheme might be a self-propelled man trip car made readily and quickly convertible from a trip car to a simple supply haulage vehicle. Still another scheme would be a rubber tired shuttle truck made to carry a standard steel flanged mine car. The mine car could be loaded with supplies at the supply house, pulled into the mine with a train of empties then rolled into the so-called rubber tired shuttle truck and hauled to the point of usage or storage on the rubber tired shuttle truck. To my knowledge, none of these schemes are presently used.

It, thus, seems that the solution to these supply haulage problems could best be studied by a committee of operating men who know the supply haulage problems and its many varying conditions. The committee could study the problem and possibly consult with manufacturers with the idea of developing a good low cost supply haulage system for the trackless area.

The above assumes that a rail and roadway will be available to the working face but if not, then the problem needs to also include getting the supplies in and over or alongside the belt or conveyor system in the trackless area. Thus, it looks like some of your energetic mine men could make some worth-while progress in this particular field. I recommend it for your consideration.

L. E. Young (*Mining Engineer*): While I agree with the last speaker that the subject of "Supply Haulage in Trackless Mining" might well be referred to one of the Coal Division committees for continuing study, it is my judgment that the author of this paper and his associates have done an admir-

able job to date and are well qualified to carry their work further. A large amount of intelligent work has been done by Mr. Fletcher and he is to be congratulated on presenting the most complete study as yet reported on this subject. Anyone who has struggled with the supply problem in mechanized mines recognizes the fact that this paper deals with some of the most important points.

Some of the ideas suggested by Mr. Brauns have been applied in other industries and we of the coal mining industry should give them most serious consideration and endeavor to take full advantage of them.

In Mr. Fletcher's paper, considerable attention is paid to the low-height new mine, but, unfortunately, there are many operators who must continue production from old mines where existing haulage systems and mine cars must be continued in service during the remaining life of the mine. In some instances, it is necessary to continue the present system of transferring outgoing coal and incoming supplies at these transfer points.

The tractor-trailer system as described by Mr. Fletcher offers many attractive possibilities, both for new mines, as well as old ones where there are handicaps of existing main-line haulage. The possibility of hauling trains of rubber-tired supply trucks deserves most serious consideration.

Several related problems of trackless mines may be noted in this connection. One is the moving of the heavy mining machinery, which must be coordinated with the moving of supplies. In a certain mine covering a large area, alternating current is used for cutting, drilling, and loading; occasionally it is necessary to move this equipment long distances in a trackless area. A two-wheeled trailer truck has been built to carry the heavy A.C. loading machine. By means of a battery-powered tractor unit, the loading machine is moved

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rapidly to the desired location. Other types of trailers have been built to meet the needs of the mine.

The idea of having special trucks or cars for handling supplies is fine. The practice of taking a standard type of shuttle car out of service and loading it with timber, drilling equipment, conveyor pans, etc., may be necessary in emergency, but it generally involves too much loss of time (for the shuttle car), while

the material is being loaded and unloaded. A trailer truck may generally be used to advantage if it can be parked or spotted where it will not interfere with haulage. This is true particularly where equipment and supplies are to be moved from working places or areas that have been finished.

It is to be hoped that Mr. Fletcher's very splendid paper will stimulate thought on this most important subject.

