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SOME HAULAGE AND HOISTING HAZARDS IN WESTERN MINES

BY

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SOME HAULAGE AND HOISTING HAZARDS IN WESTERN MINES[1/]

By E. H. Denny[2/] and H. B. Humphrey[3/]

INTRODUCTION

The subject of haulage and hoisting hazards is one that merits the attention of everyone engaged in mining. The purpose of this circular is to show the importance of such hazards as are shown by Bureau of Mines accident figures, to give some examples of recent accidents and briefly analyze the immediate contributing causes, and to discuss some general means found by metal- and coal-mining companies to minimize those hazards.

Haulage and hoisting accidents collectively constitute the second most common cause of accidents in and about coal mines and the third most common cause in and about metal mines. In both these types of mines falls of ground cause more accidents than haulage, and in metal mines falls of persons in raises and similar openings also exceed haulage accidents in number.

SUMMARY OF MINE-HAULAGE AND HOISTING ACCIDENTS, WESTERN STATES

In eight western metal-mining States, namely, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, and Washington, Bureau of Mines records show that in 1938-40 (the last years for which complete statistics are available) 30 miners were killed and 3,023 suffered lost-time injuries in metal-mine haulage and hoisting accidents; similarly, in 6 western coal-producing States, namely, Colorado, Montana, New Mexico, Utah, Washington, and Wyoming, 40 miners were killed and 1,202 were

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7228."

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injured in underground and surface haulage accidents. In proportion to the annual employment represented (56,500 in the metal mines and 22,500 in the coal mines), these injury rates were almost identical. Annually, about 19 of each 1,000 men employed were injured by this type of accident.

The following tables for metal and nonmetal mines and coal mines, respectively, compiled from Bureau of Mines publications,[4] give figures on such accidents and causes for the 3-year period 1938 to 1940, inclusive.

ACCIDENT COSTS

The compensation and medical costs of these injuries summarized in the tables, have not been published; however, a study[5] made some years ago of costs of compensable coal-mine accidents in Colorado for a 5-year period shows $355 average compensation and $67 medical cost per compensable accident.

A similar study[6] made in California shows a cost of $381 for compensation and $179 for medical aid for each compensable accident in mines insured by insurance carriers in California for the period 1928-32.

Haulage and hoisting accidents often result in loss of much time and in production delays even though no one is injured. For example, derailments may injure track, cars, and locomotives, bring down timbers and roof, and completely stop hauling. A skip or cage falling down a shaft is likely to have equally damaging consequences.

4/ Adams, Wm. W., and Kolhos, Mary E., Metal-mine Accidents in the United States During the Calendar Year 1938: Bureau of Mines Bull. 435, 1941, 52pp.; also, Metal- and Nonmetal-mine Accidents in the United States During the Calendar Year 1939: Bureau of Mines Bull. 440, 1941, 52 pp.; and later data compiled by same authors.
Adams, Wm. W., Geyer, L. E., and Parry, M. G., Coal-mine Accidents in the United States, 1938: Bureau of Mines Bull. 437, 1941, 127 pp.; and later data compiled by same authors.

5/ Denny, E. H., and Jennings, F. R., Accident Experience and Direct Cost in Some Colorado Coal Mines, 1929-33: Bureau of Mines Inf. Circ. 6860, 1935, 22 pp.

6/ Ash, S. H., Accident Experience and Cost in California Metal Mines: Bureau of Mines Inf. Circ. 6861, 1935, 32pp. (P.24.)

TABLE 1. - Metal and nonmetal mine-haulage and hoisting accidents,[1] 1938-40

	Arizona		California		Colorado		Idaho		Montana		Nevada		New Mexico		Washington		Total	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
Underground:																		
Haulage	3	385	1	566	2	296	3	366	2	475	3	282	0	118	0	51	14	2,539
Shaft:																		
Breaking cables	0	0	1	3	0	0	2	0	0	1	0	0	0	0	0	1	3	5
Overwinding	0	0	0	0	0	1	2	1	0	2	0	1	0	0	0	0	2	5
Skip, cage, or bucket	2	26	2	34	0	5	2	28	1	32	1	15	0	6	0	4	8	150
Surface:																		
Mine cars, mine locomotives, or aerial trams	0	22	0	38	0	30	0	27	0	35	0	23	0	18	0	2	0	195
Railway cars and locomotives	0	2	0	2	0	5	0	4	1	5	0	7	1	10	0	0	2	35
Open-cut:																		
Haulage	0	9	0	12	0	6	0	3	0	2	0	45	1	11	0	6	1	94
Total	5	444	4	655	2	343	9	429	4	552	4	373	2	163	0	64	30	3,023
Total 1/ mine accidents, all causes	39	4,267	47	7,022	62	3,133	41	4,450	55	4,472	46	3,175	14	1,593	6	487	310	28,599
Men employed:																		
1938	8,460		12,821		5,954		5,821		10,117		4,859		2,621		1,215		51,868	
1939	9,812		15,087		6,405		6,280		9,644		5,787		2,914		1,302		57,231	
1940	11,338		15,627		6,731		6,671		9,603		6,333		2,593		1,337		60,233	

1/ Excludes coal.

TABLE 2. - Coal-mine haulage accidents, 1938-40

	Colorado		Montana		New Mexico		Washington		Wyoming		Utah		Total	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
Underground:														
Mine cars and locomotives	14	484	3	80	0	126	5	131	9	74	4	190	35	1,085
Open pit:														
Mine cars and locomotives	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Railway cars and locomotives	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Surface:														
Mine cars and locomotives	0	29	1	3	0	5	0	8	1	12	0	15	2	72
Railway cars and locomotives	1	13	0	5	0	4	0	6	0	6	2	10	3	44
Total	15	526	4	88	0	135	5	145	10	93	6	215	40	1,202
Total coal-mine accidents, all causes	81	2,594	11	411	14	776	13	1,243	30	695	14	994	163	6,713
Men employed:														
1938	8,449		1,576		2,539		2,542		4,999		2,951		23,056	
1939	8,866		1,683		2,185		2,733		4,283		2,855		22,610	
1940	8,312		1,586		1,924		2,426		4,997		2,651		21,896	

EXAMPLES OF FATAL ACCIDENTS DURING HAULAGE AND HOISTING OPERATIONS

Ten examples of recent haulage and hoisting accidents that undoubtedly could have been avoided have been taken from a large number of similar reports. In all of these the management was responsible to a very considerable degree and in most of them the persons injured were guilty of carelessness, neglect, or ignorance.

1. Lack of Tunnel Clearance

Location. - Tunnel being driven for drainage. A bulge about 25 feet in length had been left by the drillers on the south wall of the tunnel. When the permanent track was laid, there were only a few inches of clearance at this bulge. Men walking in the tunnel had formed the habit of walking along this south wall because the air and ventilation pipes were laid against the opposite wall. An employee who had worked for only 10 days in the tunnel and had had little underground experience was accordingly walking along the bulged portion of the tunnel. He had no cap lamp, because he had given his lamp to another employee whose lamp had failed. He was depending for light on the electric lights fixed in the tunnel at 25-foot intervals, but these were obscured by water falling from the tunnel roof. An incoming locomotive pushing three loaded cars and an empty car, crushed him against the wall, causing his instant death. The locomotive operator did not see this man. After the accident the track was moved sufficiently to give clearance.

The report gives no information as to how much safety instruction the man had had or whether he had been warned as to the danger in this particular section of the tunnel. Apparently the trip was being pushed, a practice that always involves danger. No information is available as to whether a trip light was on the front car, the illumination given by the locomotive headlight, or the trip speed. The bulge could have been shot out or the track moved before the accident. Failure of the cap lamp, which left the victim without any portable means of illumination, implies neglect in charging and caring for lamps. There is also the possibility of the motorman being insufficiently alert. Apparently the main responsibility for this accident rests with management.

2. Electrocution During Switching Operations

Location. - Near an entry face of a western coal mine. Two miners were loading and switching cars. They had pushed two empty cars onto a switch, pushed three loaded cars out on the entry, and then pushed one empty from the switch toward the face. A wire carrying 440 volts alternating current was dragging across the top of the second car, and it caught on some metal part of the car, scraping the insulation from the wire and making an

electrical contact. One man pushing the car was killed, and the other was severely shocked. A third man was shocked when he touched the car and the dead man. The man killed had just returned to work after an injury, and the wire which had been installed while he was away, had been hung on a post, but the post had been knocked out 10 days before. The mine foreman was sufficiently sensible of the danger from the sagging wire to warn other men not to use this side track for changing cars, but he had not warned the victims. No warning or danger signs were posted, nor was the sidetrack blocked off. Apparently there was no circuit-breaker on the feed line. The report does not state whether artificial resuscitation was attempted or whether the men present were trained in first aid.

This accident illustrates the carelessness with which ordinary electric wires carrying potential death in the form of 220-, 250-, or, as in this instance, 440-volt current are often handled underground. Possibly the men did not realize that the insulation might be broken or that the insulation itself might afford no protection because of dampness and wear. The man killed may have been habitually careless; he had been injured only a few days before the fatal accident. Evidently the foreman was insufficiently informed regarding the hazard and was himself careless in this instance. Feed and trolley wires require guarding if men can come in contact with them; otherwise, fatalities from such accidents will occur inevitably and needlessly. Bureau of Mines Mine Safety Board decision 24 states, in part:

> Trolley and other bare wires should be adequately guarded wherever the wire is less than 6 1/2 feet above the level of the top of the rail.***. Power lines should always have well-grounded armored covering.

3. and 4. Men Crushed Between Chute and Haulage Equipment

A motorman was crushed between a locomotive and a chute in a western metal mine. He died of internal injuries. At the time of the accident he was facing back toward the train and was caught against a projecting chute lip.

Small western metal mine: A trammer was fatally injured, receiving fractures and internal injuries, while he was riding on the coupling between two ore cars pulled by a mule in a haulage tunnel. He failed to lean sidewise to miss the chute mouth and was caught between the chute and the second car. Following this accident, a platform was provided behind the last car for the trammer to ride upon.

Many mines have impaired clearance at chutes. Motormen, trammers, and other employees recognize such danger at chutes and usually remember to keep themselves in the clear. Nevertheless, numerous accidents similar

to the two just described occur. A motorman frequently needs to look backward as well as forward when handling cars. In some mines the use of large cars automatically causes chutes to be placed high, with more clearance. Also, some types of ore deposits lend themselves to chute installations with adequate clearance. Nevertheless, where timbers are large and ground heavy, or where chutes are built low to facilitate transfer of rock to small cars without spillage, it is difficult to avoid a real hazard from insufficient clearance at chutes. In some instances an adjustable chute lip that could be raised out of the way would offer possibilities. In other instances a small piece of canvas hung near each chute, against which the motorman might strike would serve automatically to warn the motorman or trammer in time to avoid an accident. Or, reflector buttons on chutes might give better visual warning. The subject of chute clearance deserves considerable study. When the trammer rides between cars an additional hazard is present in the event of a wreck or derailment; this dangerous practice may have been due to the man's carelessness, but it was probably a practice tacitly allowed by the supervisory officials.

5. Lack of Man Clearance Between Timbers and Train

A miner was working in a raise in a large metal mine and came down to the drift. He walked along the drift, and when he came to a train of 17 cars of ore that was waiting for a signal to start for the shaft he walked at the right of the train until he was opposite a drinking fountain; then he crossed between the cars. The train started, and he was caught between a post and a car with resulting crushed pelvis, internal hemorrhage, and death.

In the investigation of this accident the question was raised whether the drinking fountain was in the proper place. Evidently it was on the narrow side of the drift and near a place where there was no clearance.

The tendency toward greater speed and the use of larger cars in haulage drifts designed for small cars increases the possibility of men being injured at points of insufficient clearance. In many instances it is impracticable to assure enough clearance at all places, even on one side of the drift. Frequent well-marked shelter or refuge holes should be made available, and warning signs should be used freely; speed restrictions and good illumination at places with little clearance should also help. In addition, the necessity of individual carefulness should be brought to the attention of each worker.

6. Hoisting of Tools With Men

Metal mine: A number of pieces of drill steel and six men were being hoisted in a cage. One or more of the drills caught in the shaft timbering, and several of the men were killed and badly mutilated. This practice was

a definite violation of the State law and company rules; however, the chances are that it had been followed for some time without serious objection by officials. After the accident, the superintendent of a neighboring company devised a portable container to hold drill steel.

7. Fall of Bucket in Shaft

Medium-size western gold mine. - A miner was fatally injured by a falling bucket. A 200-pound sinking bucket was suspended beneath the cage in a vertical shaft by a rope 15 feet long. The brake lining on the hoist had been changed two days before, and the brake was not yet operating smoothly. The shaft-sinking crew was late in completing the round and was in a hurry to get to the surface at the end of the shift. The safety hook holding the bucket was defective, and the jerking of the tight brakes caused the bucket to become detached from the hook. When it reached the bottom it hit the miner a glancing blow, although he was sheltered under the manway compartment. His skull was crushed, and his neck was broken.

The inspector's report concluded that both the brake mechanism and the safety catch holding the bucket were defective.

8. Riding Rim of Skip or Bucket

Large Gold Mine. - A mucker suffered fatal internal injuries while riding on the bail of a skip. At one time signs had been placed in the incline shaft of this mine forbidding men to ride on the bail of the skip, but these signs had, disappeared before this accident occurred and it was customary for men to ride thus. Subsequently the order against riding the bail was again put into effect.

Fatalities from this same cause occur yearly. Although the dangers of riding on the bail of buckets have been recognized and the practice is often forbidden by company or State safety rules, it continues, largely because of the difficulty of attaching a second man-skip to an ore-skip or changing from one to the other before and after the transportation of men. Riding on the bail, rim, or crosshead without mishap depends on nothing happening to jar or pull men off, and on riders maintaining clearance, a firm grip on the rope, and a firm footing on the bail or rim of the skip or bucket. It is too much to ask that these necessary precautions be observed in everyday employment, and a safer means of passage through shaft openings should be provided. There may be mines where riding inside the bucket or skip presents an equal hazard; in such instances extensive changes in hoisting equipment or methods may be needed.

9. Death of Engineer During Hoisting of Men

Western coal mine. - The man-trip with more than 100 men aboard was being hoisted up the slope at moderate speed. The hoisting engineer fell dead from a heart attack, and there was no other attendant at the hoist. When the trip passed the first entry below the portal, the mine foreman on the trip noticed that, contrary to usual practice, it was not being slowed up. He called to his men to be ready to jump when the trip reached the portal. Fortunately there was ample level ground on the surface and all jumped off and only two men received minor bruises. The trip went through the tipple, and the cars dropped to the loading track below.

Company rules provided for a second man at the hoist when man-trips were being hoisted and lowered. How often this rule may have been broken is not known. The hoist should have been equipped with an automatic control requiring pressure of a man's foot for the hoist to operate.

10. Improvised Hoisting Equipment

Small western gold mine. - A foreman and three other men were on a skip at the collar of a shaft. The hoisting engineer threw out the clutch to start the converted automobile engine, which served as the source of power, leaving the weight of the skip to be held by the single brake. The brake started to slip, and when the engineer pulled on the brake lever to stop the skip a bolt on the brake band broke, and at the same time the engineer was held against the side of the building by the brake handle. He released himself and attempted to stop the skip by jamming a piece of steel against the drum, but this was ineffective. The skip jumped the track and knocked out about 10 sets of timbers before it stopped at a spot where the grade was flat. One man jumped off at the collar of the shaft and received a broken ankle. Two men in the bottom of the skip stayed in it and escaped injury. The foreman, riding on the bail, was thrown against the shaft timbers and crushed to death.

Since this accident, the State concerned has made it mandatory to have two independent effective brakes on all man hoists.

This accident was due to the use of improvised hoisting equipment, a practice reported in recent years at numerous small metal and coal mines. It would seem that any regard for safety in mining would require the installation of hoisting equipment designated for mine use and in proper operating condition. Manufacturers of mine hoists can be relied upon to furnish a sturdy product, adequately safeguarded, that will perform the work required if they have knowledge of the conditions under which it is to perform.

ACCIDENT CAUSES

The preceding examples illustrate several of the hazards and shortcomings that lead to accidents in haulage and hoisting operations. Other common causes are runaway trains or trips, derailments, collisions, poor car-coupling practices, and failure to secure cars on pitches.

In most accidents there are a number of contributory causes, and sometimes an accident report fails to recognize the more important of these. For example, one report examined stated that the man killed was supposed to guard his own safety and keep in mind such places in the tunnel as had little clearance. The report stated further that the man killed had worked in the tunnel for only 10 days. It is true that a worker has a very definite responsibility to perform his duties in a safe manner and that no system of supervision and safeguards can be devised that will at all times protect a careless man. But the employer has the duty of furnishing and maintaining a reasonably safe and healthful place of employment, and his duty should include education of employees in the particular hazards of their occupation and immediate surroundings and supervision to assure that places of employment remain safe and that work is performed safely as well as efficiently.

HAULAGE SAFETY PROBLEMS

The measures that should be taken to minimize the chance of recurrence of most haulage and hoisting accidents are readily determinable. Such measures generally have not been taken in the past because of failure to recognize the hazard and the belief or hope that a known hazard will not result in accident, or for reasons of supposed economy.

Some haulage safety problems, however, are difficult to solve. Often this is due to original mine lay-out or unusual natural conditions. What to do in some cases remains uncertain, but the problem of working out some means of lessening the hazard should not be neglected on this account. Too often, men operating or riding on haulage or hoisting equipment have to depend on alertness and agility to hold on and to dodge obstructions, because the company has not provided equipment nor taken measures to assure reasonable haulage or hoisting safety.

Some haulage safety problems follow:

1. Handling men in shafts and inclines in which there are only one or two compartments and skips or buckets are used constantly for hoisting broken rock; change to a man or supply skip or attachment of man skip to ore skip is considered impractical.

Elimination of man hoisting during working shifts and provision of a suitable skip for hoisting men would seem partly to solve this problem. If the ore is badly needed for war purposes, and curtailment of products would result from such measures, it should be remembered that conservation of life and limb of miners for war production are also important. In some such instances a new opening for use in hoisting men may solve the problem.

2. Riding within or on the bail of the skip or bucket.

Even though the record at some mines indicates greater safety of riding on the bail rather than inside the skip or bucket, it would seem that at such mines neither is safe inasmuch as riding the bail is inherently dangerous, owing to insecurity of the rider's position, proximity of shaft walls, and the shaft itself. A separate man skip or bucket seems to be indicated here.

3. Lack of acceptable device to stop runaway skips or man-cars in steeply inclined shafts.

One or more man-cars designed for use under such conditions will, it is claimed, stop the car if the rope breaks near it. Concerted demand by the mining industry for satisfactory devices undoubtedly will cause one to be made available. This problem could be solved in part by handling skips and man-cars slowly and carefully, maintaining track and skips or cars in good condition, using an auxiliary fastening between cars or skips and the main rope, using a good main rope, and inspecting it frequently.

4. Maintenance of man clearance between chute lips and timbers for motorman and helper.

A retractable chute lip could be used if chutes are not constructed to give man clearance. If locomotives had cabs for the motormen they would have some protection, but chutes without cab clearance would have to be changed. Lights at chutes, reflector buttons on chutes, canvas near chutes to warn motormen, and slower haulage speed are partial answers. Points of inadequate clearance at timbers could be lighted as warning.

MEASURES TAKEN TO MINIMIZE HAULAGE AND HOISTING HAZARDS

Many mining companies, both large and small, successfully minimize haulage and hoisting hazards and the accidents resulting therefrom by well-considered safety measures. The methods used by any large company are likely to embody the following:

1. Compliance with State mining laws.

2. Well-maintained track and road bed with rail weight and ties adequate to carry the load at good speed without derailments.

3. Good brakes on well-maintained cars.

4. Frogs and switches suitable for the traffic involved and laid to present a minimum of stumbling hazard.

5. Trolley and feed wires guarded against man contact.

6. Where feasible, a man travelway separate from mechanical haulage.

7. A well-lighted haulageway with ample man clearance on one side and well-marked shelter or refuge holes at frequent intervals where men can go and be safe from any trip wreck and derailment.

CONCLUSION

Numerous reports on haulage and hoisting accidents in the Western States demonstrate that too many such accidents occur and that many of them could be avoided. This statement also holds for such accidents in the other mining States. Numerous fatalities have occurred, even from unsuitable equipment and failure to maintain man clearance.

Many mining companies have adopted safety practices that have minimized the number of haulage and hoisting accidents at their operations; other companies could adopt many of these practices with resulting greater safety.

Conservation of miner manpower is vital to our prosecution of the war as well as increased mine production; reasonable safety can be obtained, usually with greater efficiency.