FAST, LOW-COST placer mining for small operators is possible with dozers and mobile belt conveyors. Above, a D-8 Cat pushes a load of Klondike gold-bearing muck onto a horizontal section of the conveyor. Adjustable chains regulate the surge loads

Belt Conveyors Speed Placer Mining

HAROLD H. SCHMIDT

A DOZER-BELT CONVEYOR OPERATION, such as we evolved in the Klondike, is a fast, low-cost method for open cut placer mining. Basically, it consists of mobile conveyors, a sluice box and a dozer or two. This equipment can be used in various combinations.

In most open cut placer operations, a dozer pushes gravel to boxes and another dozer or dragline stacks tailings. The most expensive part of the operation is the use of dozers and, when they are used for tailings disposal, their costs may be double that of machines used in the cut. With hourly costs and production time constant, costs per yd are directly related to the distance the material is moved with the dozers.

Dozers are an efficient and low-cost means of moving material when the material is:

- dry or reasonably dry
- pushed level or downhill
- pushed 50 ft or less
- reasonably easy to dig or loosen with minimum ripping.

In developing our technique in the Klondike District near Dawson City, Yukon Territory, we first tried a belt conveyor on the most expensive part of our operation—stacking tailings. This was done by discharging the sluice boxes directly into a hopper from which the skirted conveyor pulled the unsized material, while the water and slimes overflowed.

As long as the material being sluiced had a substantial amount of rock and gravel and the discharge from the boxes was reasonably uniform and did not reflect the surge nature of the dozer load entering the dump box, the practice worked. It did not work when large amounts of clay, muck or soft bedrock went through the boxes without being disintegrated. Another disadvantage: surge loads coming down the boxes would overflow coarser sands and fill the drain.

Why We Selected A Feed Conveyor

Thus, under favorable conditions, using a conveyor to stack tailings was encouraging and we believed we could overcome the other problems by a feed conveyor which would give us:

- a steady uniform rate of feed
- a low-cost elevating medium to give sufficient height to do a good job of washing, sizing and dewatering
- a unit with good mobility so that moving and setting-up time could be kept to a minimum.

Mobility is very important: the more flexible and mobile your unit the shorter will be the distance you move the gravel. In other words, if you can move in 10 or 15 minutes, you will move fast and often; but if you require 5 to 6 hours, you will have to move the material greater distances in order to have fewer unit moves.

Developing Our Feed Conveyor

Initially we believed that it would be necessary to have a heavy-duty apron feeder for the unit we would doze on, and this feeder would in turn discharge onto a conventional belt conveyor. Upon investigation, the weight of this unit discouraged us as we felt that we would lose mobility.

Finally, we decided on an experimental unit using a 30-in. belt conveyor with an over-all length of 60 ft from head to tail pulley. Of this length, 16 ft represented a horizontal section with a loading height 28 in. above ground level. The horizontal section was skirted to expose the belt 9 in. at the back end. This width widened to 13 in. in the direction the belt moved. Just before leaving the

Mr. Schmidt, a native of Alaska and a mining engineer, has been engaged in placer gold mining in Alaska and Yukon Territory continuously (except for World War II) for the past 25 years. Currently he is operating several properties in Yukon Territory in association with Glen D. Franklin under the firm name of Ballarat Mines Ltd. Mr. Schmidt resides at 1400 Felta Road, Healdsburg, Calif.

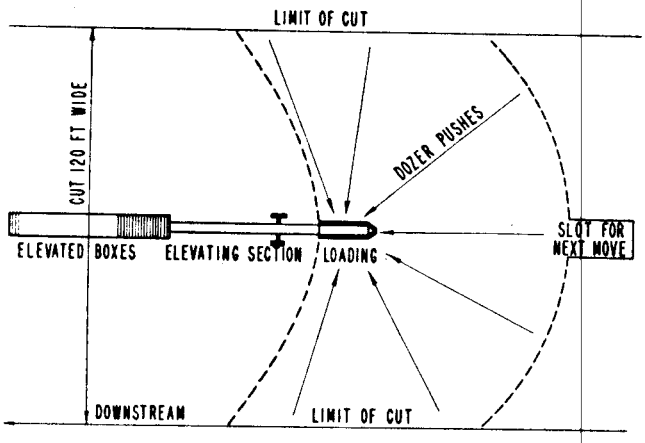

FIG. 1 In open country, where the dozer can back beyond the cut limits, the above pattern is used for dozing to conveyor.

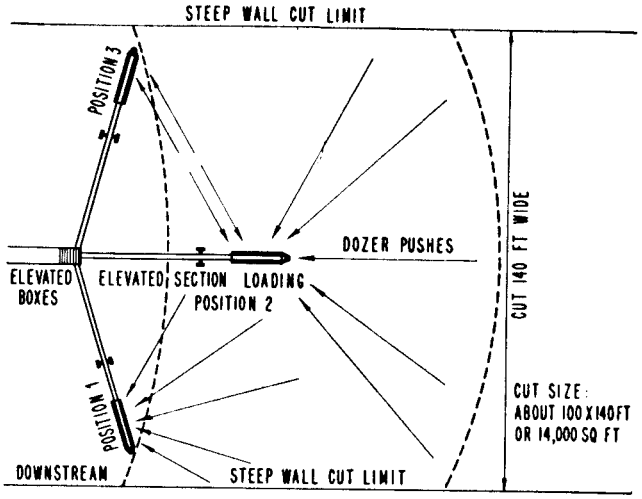

FIG. 2 Where the dozer can't back beyond the cut limits, the conveyor is extended to the side to give a straight push.

skirted section, an adjustable weighted chain was used as a load regulator. In the next 4 ft the conveyor changed from the horizontal loading section to the elevating portion at 16°.

The unit was mounted on rubber tires from "surplus aircraft" beaching gear. The axle was placed so the center of gravity was slightly on the loading end. A drawbar hitch was also placed on this end. A 10-hp electric motor was mounted at the discharge end of the conveyor. Electric power was furnished by a D4 power generating unit on skids. Numerous belt speeds were tried on this particular unit, and we ended up with 150 fpm. In our opinion, a slightly lower speed would be better but, because of the narrow 30-in. belt. we had to maintain this speed to obtain capacity. The spacing of troughing rollers in the loading section should not exceed 24 in.

Setup and Operation

The sluice plant of elevated boxes and the belt conveyor were kept on cleaned bedrock. When the dozer could back up beyond the mining width without difficulty, the conveyor loading section was pulled into a slot about 15 ft wide in the center of the mining width and extended up into the cut some 20 ft. The conveyor discharged into a washing plant directly downstream. Material was dozed onto the loading section from both sides and upstream for a maximum push of 60 ft, except when dozing directly upstream from the unit. At that point, a dozer width for 80 ft was cleaned to prepare the slot for the next move (Fig. 1).

When steep walls or stripping piles on the limits prevented the tractor from backing up beyond the mining width, the washing plant remained in the center, but the conveyor loading section was placed near a cut limit so that the tractor could push as nearly straight downstream as possible. After the area was cleaned within economic push limits, the loading section was positioned in the center of the mining width and material within the economic push limits of this location handled. A pattern similar to a dredge arc results in following these procedures (Fig. 2).

This system offers the following advantages:

1 Most material can be moved downhill or on a level because of low loading height.

2 Material is fed uniformly to washing plant.

3 The feeder is flexible and can be positioned so that the dozer makes practically all straight pushes.

4 Only about two dozer loads of material are left around the loading section when ready to move.

5 The unit is an economical elevating and transporting medium.

6 Poor drainage conditions can be handled by positioning the feeder unit to take advantage of natural conditions.

7 Because the unit is mobile, fast and easy to move, short and frequent moves are possible.

Disadvantages are:

1 It is necessary to operate and to maintain another unit.

2 Under conditions of moist soil or clay, a bad "arching" situation would develop so that an attendant would have to break the material down with a shovel or bar to keep it feeding. From observation it is believed that this would not be a problem with a 42-in belt.

The maximum capacity of the unit was about 135 cu yd per hr. Moves required 1 hr, but this time could definitely be lowered. The unit was used for a total of about 1200 operating hours and showed no rock damage and scarcely any wear.

New Units Planned

From our work with this experimental model, we believe that a similar 42-in. unit with modifications is the answer for feeding and elevating material to a washing plant. In order to keep a washing plant light and mobile, we anticipate stacking the oversize with another belt conveyor mounted on a D8 tractor using hydraulic dozer controls to raise or lower the conveyor frame. This D8 unit would also have a generator mounted on it to furnish electric power for the feed conveyor, stacking conveyor, and a sand pump to stack the undersize. The undersize sands would be pumped through a line suspended underneath the stacker and discharged through a controlled end that could be directed as a monitor. This monitor could then "blast" the coarse tails of the stacker as they are discharged, thereby increasing the volume of tails from a single stacker position by spreading them. Connection between the sand pump mounted on the washing plant and fixed line on the stacker would be by rubber hose and "Pierce" couplings.

This unit should have a daily (24 hr) capacity of from 4000 to 5000 yd under average conditions and require 2 men on a shift. Maintenance costs should be considerably lower than with a conventional dozer or dozer-dragline open cut operation.