guards are made with the metal turned up on the sides to prevent the material from falling in case it becomes disengaged from a hook or carrier. The only points at which the conveyor runs near the floor are at the unloading and loading stations. At these points the track is guarded with an umbrella sheet-iron guard, completely inclosing all moving parts. The driving and idler sprocket and caterpillar chain on the drives are inclosed in a sheet-metal guard. Every precaution has been made to make this system safe.

Scheduling of Material

The scheduling of material plays an important part in the operation of the conveyor. The material movement of parts from the contributing section and DR-1 section must be synchronized with the operations of the assembly line. Miscellaneous stock parts must be scheduled in accordance to production requirements. Rework parts and other material must be scheduled as fast as they are repaired.

The scheduling of stock parts is routed by a numbering system. Those parts which are common to both DR-1 and D-2 units are routed to the different sections in different quantities, which makes it necessary to have some system whereby the person at the station where they are to be unloaded will know which allotment is to be unloaded. By a numbering system, for example, a tote-box container filled with stock parts scheduled for station No. 1 is numbered by means of a clip with a corresponding number, so that the material is conveyed directly to the station where it is unloaded.

The synchronizing of material movement between two sections is maintained by painting the hooks for one section a different color than those used for another section. These colored hooks are spaced so that the inflow of material at the assembly line is at the same rate as the outgoing. To take care of any fluctuation in the assembly line or conveyor delivery, a space has been allowed at each station for a small buffer stock.

The installation of this conveyor system has resulted in linking together four different sections located in 12 separate buildings, and in maintaining a uniform flow of material.

Discussion

Jervis B. Webb.[2] For a number of years the problem of driving long conveyors with multiple drives had not been entirely satisfactorily worked out. The Webb Company had worked out problems of this nature from many angles, but a considerable amount of care and attention and adjustment had always been necessary on the methods heretofore used.

One of the first types of multiple drive was used at the Ford Motor Company in Toronto, where three individual drives using the alternating-current type of motors, having as nearly as possible the same characteristics, were connected to one conveyor chain at convenient points, so located as to balance the load as nearly as possible. The system was worked out on the basis that an ordinary a.-c. squirrel-cage motor has a slight variation in full-load and no-load speed—that is, no-load speed would be around 1200 r.p.m. and full-load speed around 1140 r.p.m. As the motors were selected to have practically identical characteristics and the load was fairly evenly balanced, any discrepancy in speed would be taken care of by this slight slippage.

This installation proved to be very satisfactory, but when adopted, in a number of instances, due to the inability to get equal loading and accurate similar characteristics of motors, much difficulty was experienced. One drive was found to take all the load, or even to try to pull through the other drive; and of course this type of system was of constant speed. This system also had its limitations in that, on a slow-speed conveyor, where the reduction in speed from the motor involved a considerable amount of gearing or a large ratio, it did take a tremendous pull on the driven chain to have any appreciable effect upon the lag in the motor, so that on slow-moving jobs the difficulty was even greater. On fast-moving jobs it was easier to get proper distribution of load per drives.

Another form of multiple-drive application is one where all drives are driven from a single motor with possibly a Reeves for varying the speed and the power being transmitted by means of a shaft to several drive units. The first obvious limitation of this is that the drives must be reasonably close together, in order to be able to connect them mechanically. The second objection to it is that in a long conveyor any 1000 pitches of chain will vary in its total length quite a little from any other 1000 ft. of chain in the conveyor. This is due to wear, strain, or general conditions, and it inevitably works out that certain lengths of the chain, which correspond to the same number of pitches in another part of the chain, will be shorter or longer. Inasmuch as the individual drives turn the chain, pitch for pitch, being mechanically connected, when a certain part of the conveyor chain is between two certain drives, it may have a very slack or loose condition of the chain, while this same section of the conveyor, when it has passed by one drive and is now between another set of two drives, may be tight. In long conveyors this slack frequently amounts to several feet. If the slack is taken out at the point where it occurs between two certain drives, when the conveyor is started up and that conveyor chain passes beyond one of those drives, there being so many less pitches in that section than there was before, the system tightens up and breaks the chain.

The only safe solution when such a condition occurs in a conveyor is to break up the main conveyor chain into small units, and redistribute them, so that any 500 or 1000 ft. of it equals any other 500 or 1000 ft. in length. This is a difficult job and requires considerable expense, and has to be done from time to time. Also careful adjustment of the drives has to be made frequently.

Another type of drive for handling this problem is the synchronous-motor type of drive which electrically holds the drives together, much in the same manner as when they are mechanically connected, and much of the same problem is presented. The difference in pitches of chain frequently causes one drive to pull against the other or introduces very heavy initial tensions between drives, due to shortness in pitch. Actual tests with a dynamometer chain-pull measuring device have been made on such drive constructions and have proved this point.

With the floating type of drive, which has been described in the paper, and which we designed to meet this particular problem, when the strain occurs on an individual drive, due to any condition, the drive pulls back against the springs, which slows up its speed and relieves its tension, and as it were "passes the buck" on to the next drive that otherwise would try to take it off. It thus operates to even up the pull on the chain at any one point. One of its most important factors, however, is that the pull is always against springs, which give under shock, particularly in connection with long systems where possibilities of foreign obstacles may occur. Sudden stoppages of a conveyor while in motion put great strains on drives, even though shear pins are present. While coming up against the spring the shock is cushioned. All of this makes for longer life of the system.

Then there is the additional factor of safety of the limit switch which operates when the spring is fully compressed, shutting off the power on all drives. The system described also has the advantage of making it possible to vary the speed of the whole

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system. Also, the drive, being of the caterpillar type, permits of placement at practically any advantageous spot on the conveyor system.

In other words, a boost or a pull can be introduced at any desirable spot on a conveyor by the use of such a system. One interesting use of this is on long inclines. One of these floating-booster type of drives is inserted part way up the incline, and the springs are adjusted to take a certain amount of the pull, thus operating to reduce the total strain of the chain by one-half, or whatever amount is desired at this point.