IMHC

INTERNATIONAL MATERIALS HANDLING CONFERENCE

BELTCON 3

Protect your Conveyor Belt Investment

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The S.A. Institute of Materials Handling
The S.A. Institution of Mechanical Engineers
The Materials Handling Research Group (University of the Witwatersrand)

PROTECT YOUR CONVEYOR BELTING INVESTMENT

1. SUMMARY

Conveyors can be thrown together with almost any old kind of equipment. They can be abused and neglected and still the belting will keep plodding along, it will run over idlers that haven't turned for years, drag itself through accumulations of the material that it is supposed to carry, that has buried the idlers that are supposed to make its running easy.

It will even, due to misalignment of the conveyor frame, cut its way through steel members in trying to do its work!

But treat a belt right and it will respond with years and millions of tons of increased life and service!

This paper addresses the importance of high standards of storage, handling and maintenance.

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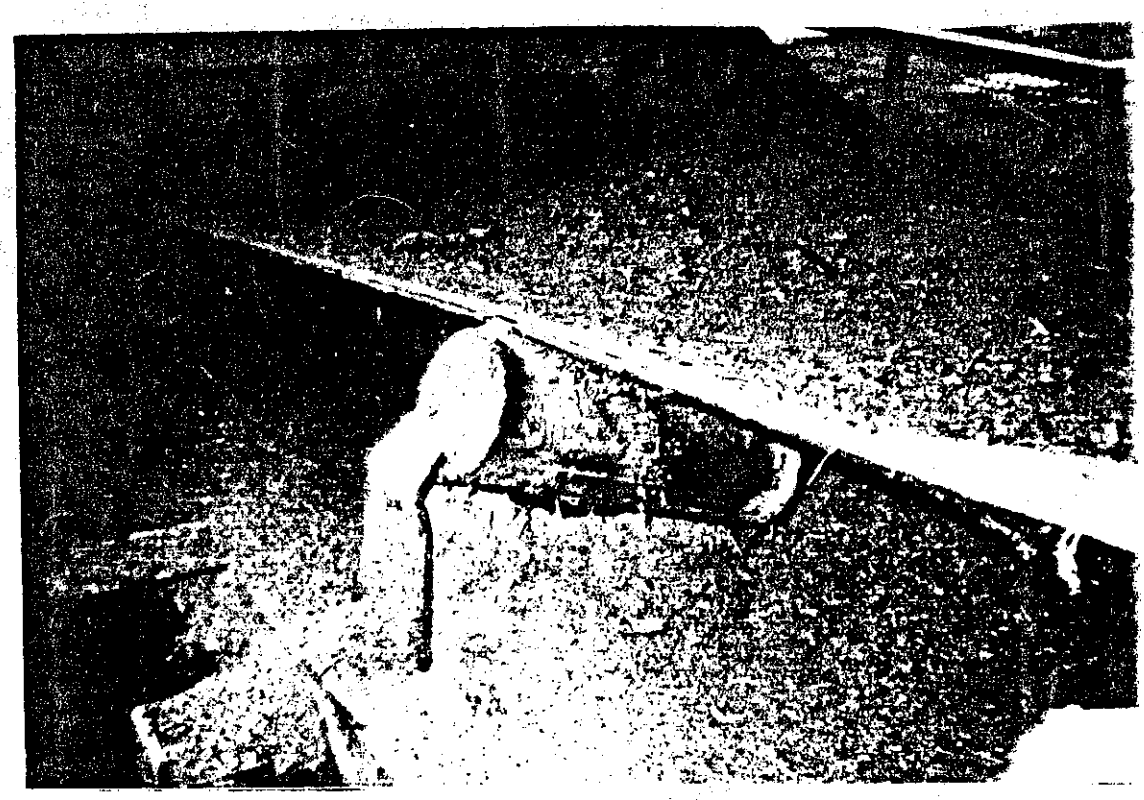
THE GOODYEAR TYRE & RUBBER CO (S A) (PTY) LTD

PROTECT YOUR CONVEYOR BELTING INVESTMENT

2. INTRODUCTION

In this paper we will endeavour to impress upon users the importance of high standards of storage handling, maintenance, and inspections of conveyor belts and conveyor belt systems.

Basic maintenance of conveyor belt systems have not changed much over the years, but the neglect and abuse of these systems in our country highlights the need for a refresher course on the subject.

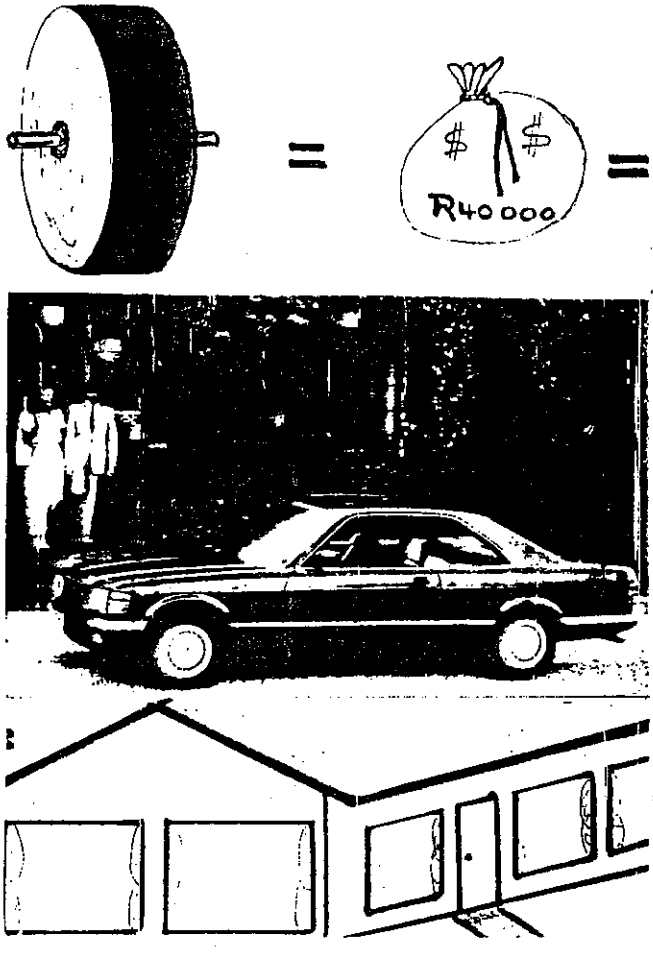


Why is it so terribly important to handle a conveyor belt with care and maintain it in good order?

I can think of one good reason; the amount of money the user must pay for the commodity!

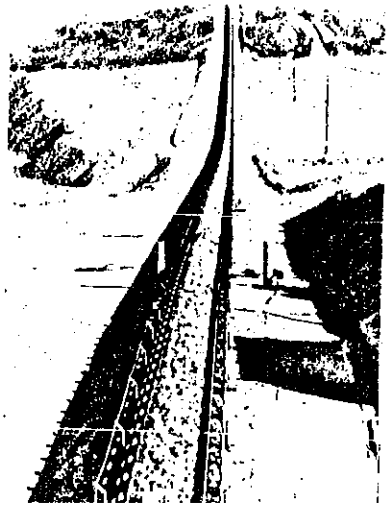
It may be the single most expensive item in your plant.

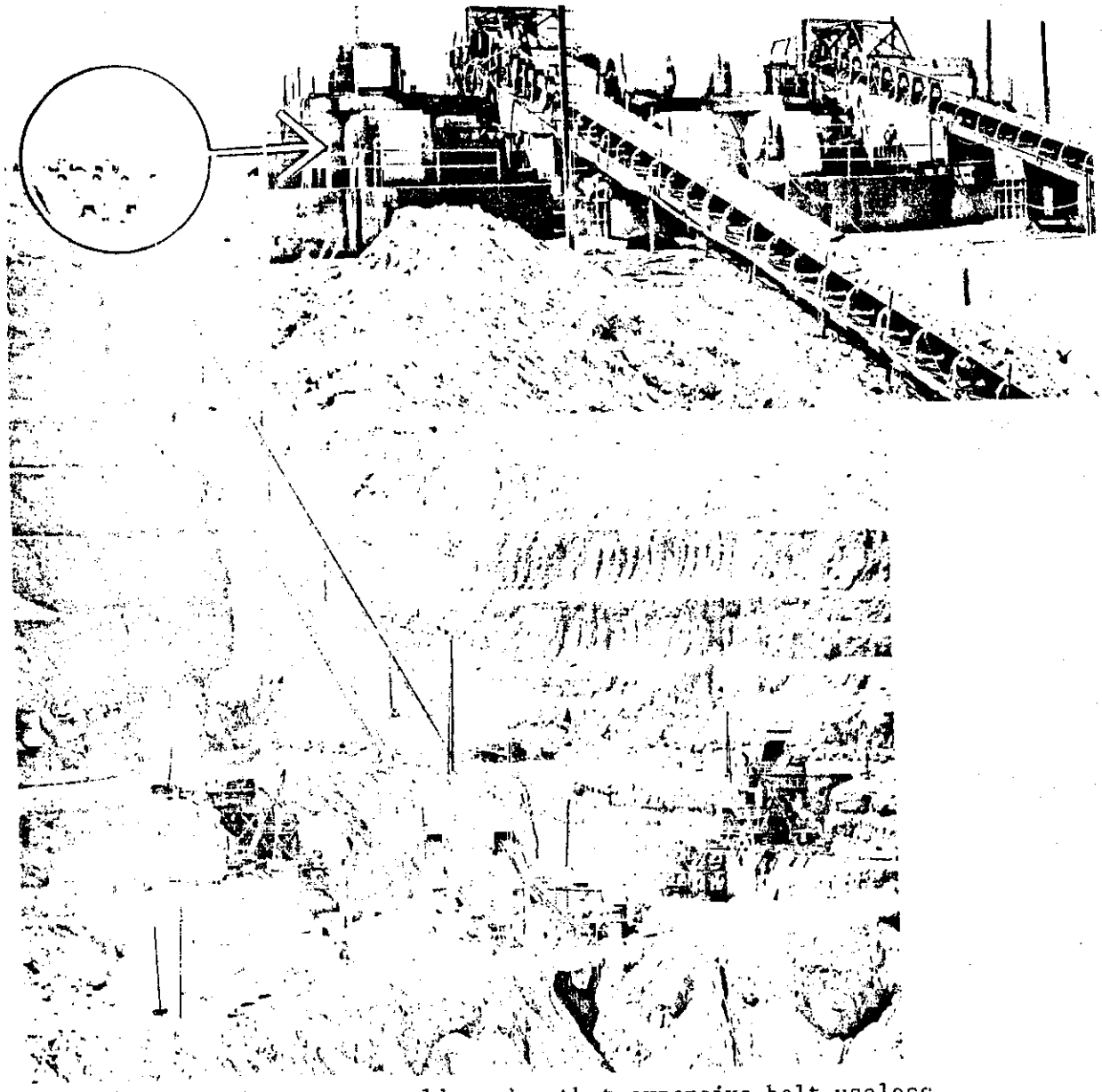
A roll of conveyor belting arriving at your store may cost anything between fifteen and a thousand Rand ..... per metre!



That roll of belting may have cost your company the equivalent price of a luxury car or a house.

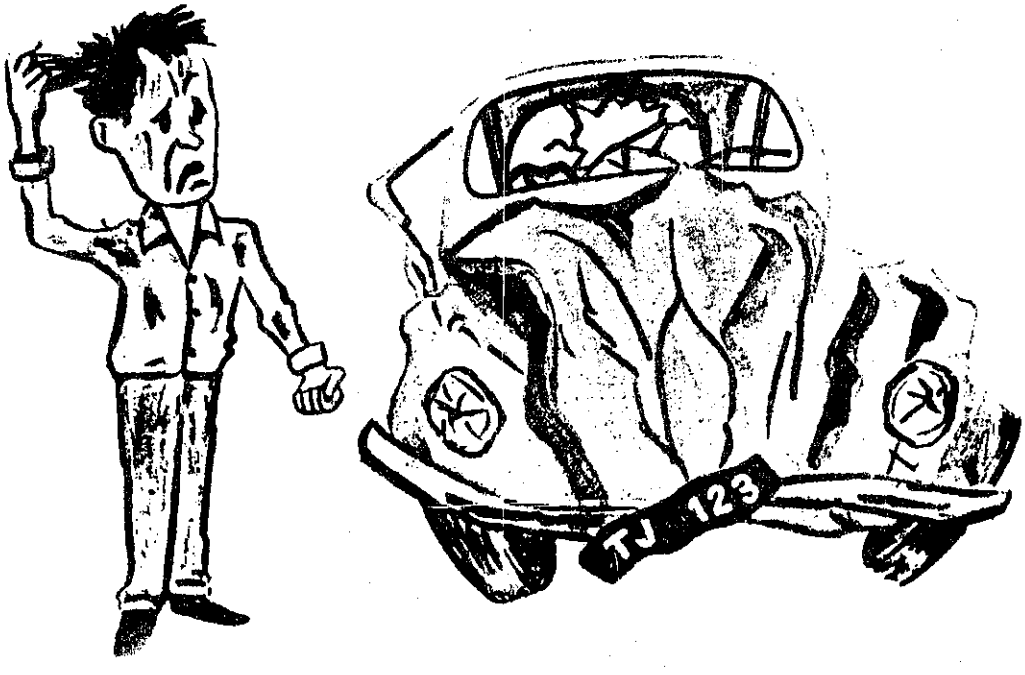
A full-length installed belt may have cost a million Rand or more.



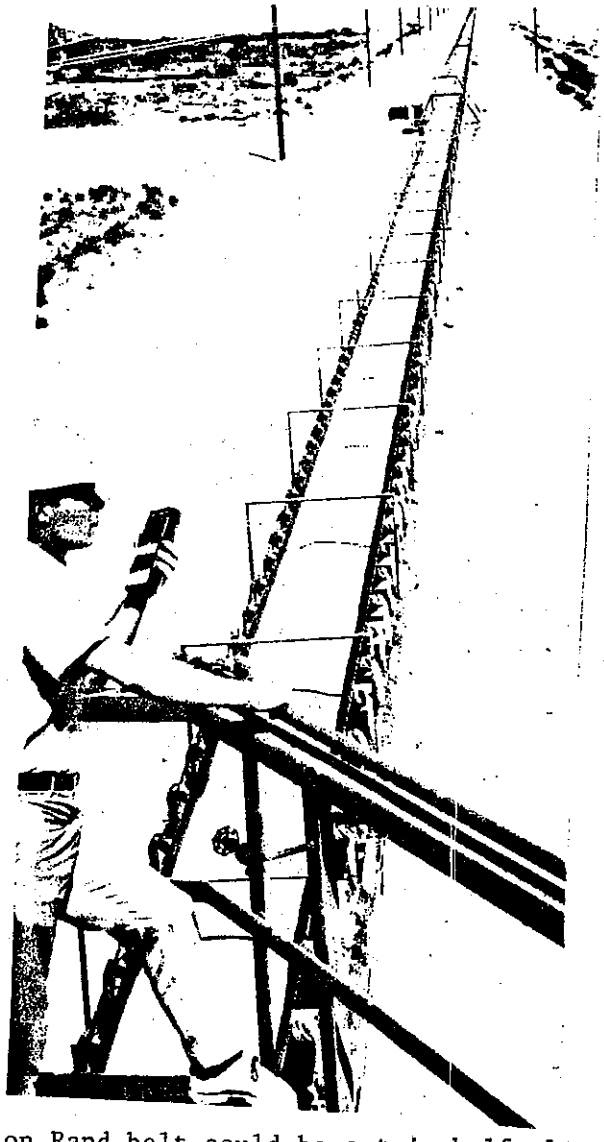


Substandard maintenance could render that expensive belt useless within months - and who gets the blame?

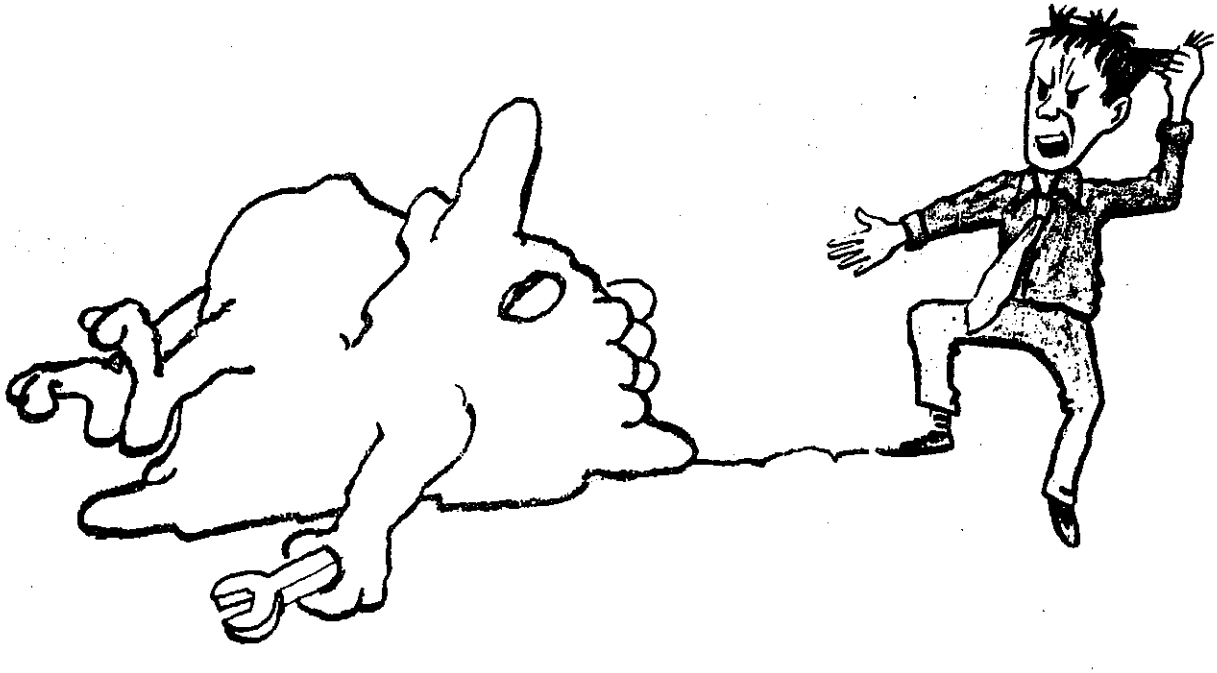
The belt and the belt manufacturer!



It is like blaming the car manufacturer because his car crumples up when driven into a stone wall.



A multi-million Rand belt could be cut in half along its full length in a matter of minutes - and who gets the blame?



Night Shift!

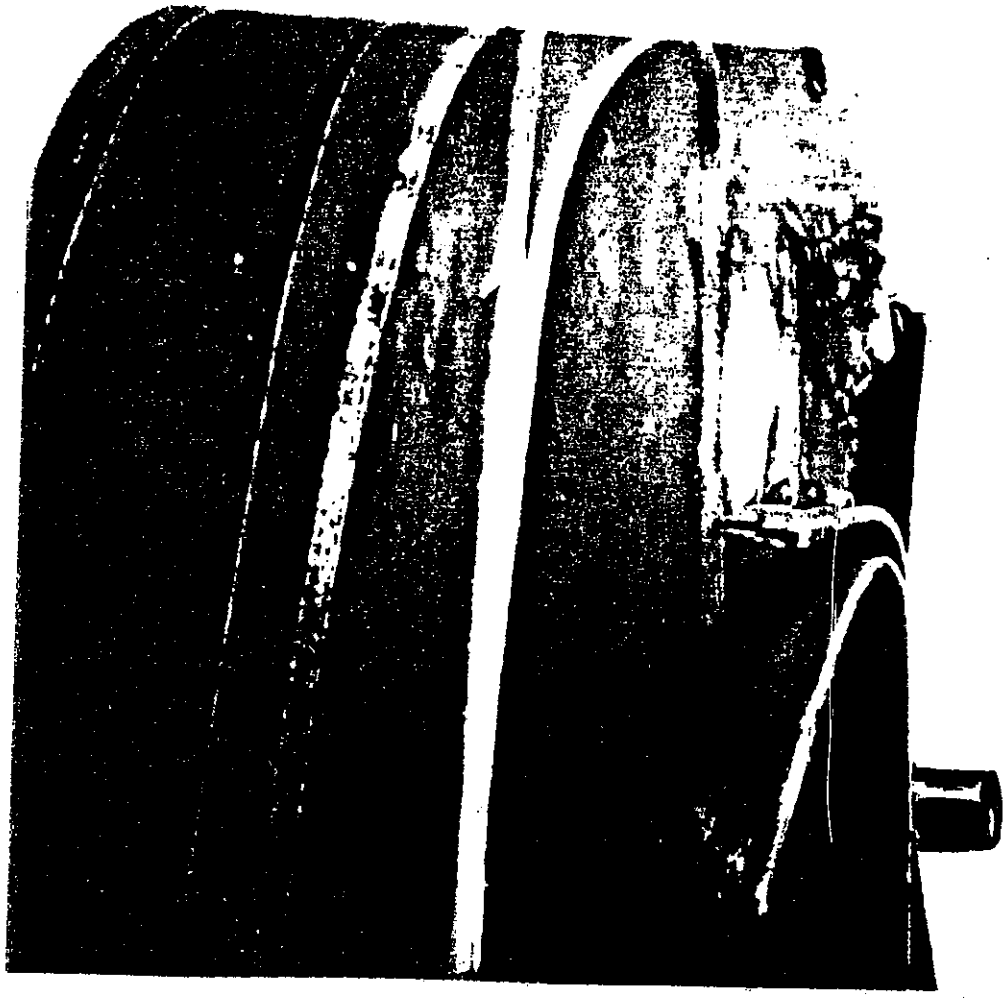
Yet, there are safety devices on the market, which could prevent such damage and which do not depend on the human element.

3. HANDLING CONVEYOR BELTING

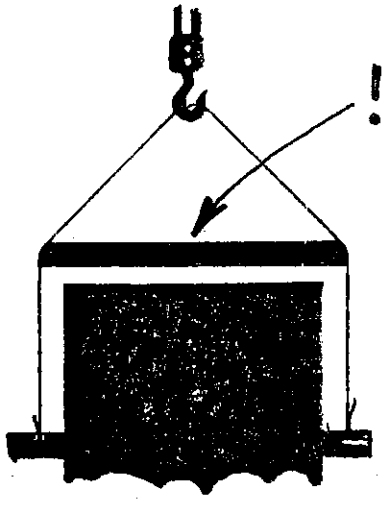
3.1 OFF-LOADING

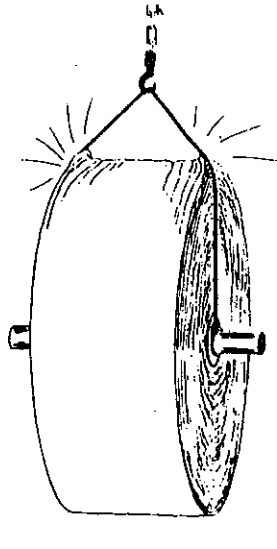
Lets start with the belt arriving at your store or on site.

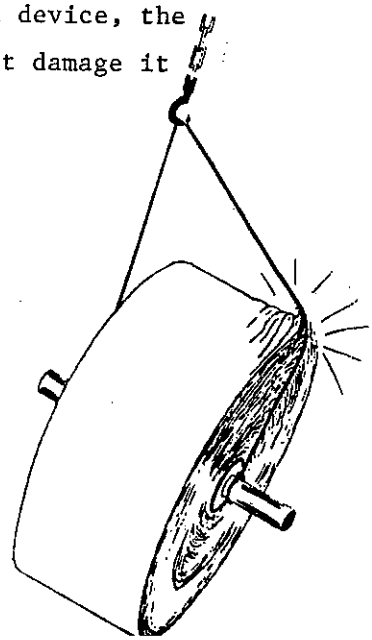
How should the belt be off-loaded?



The belt should be hoisted with an overhead crane and it is very important to use a spreader bar. By using such a device, the cables and/or chains used to hoist the belt cannot damage it during transit.

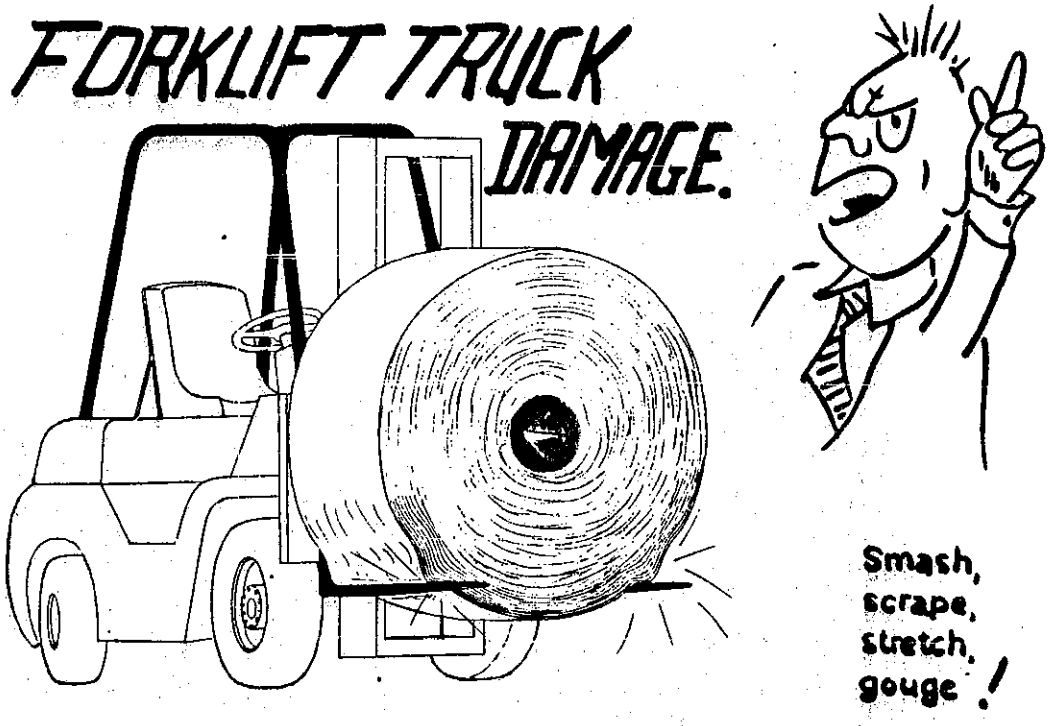




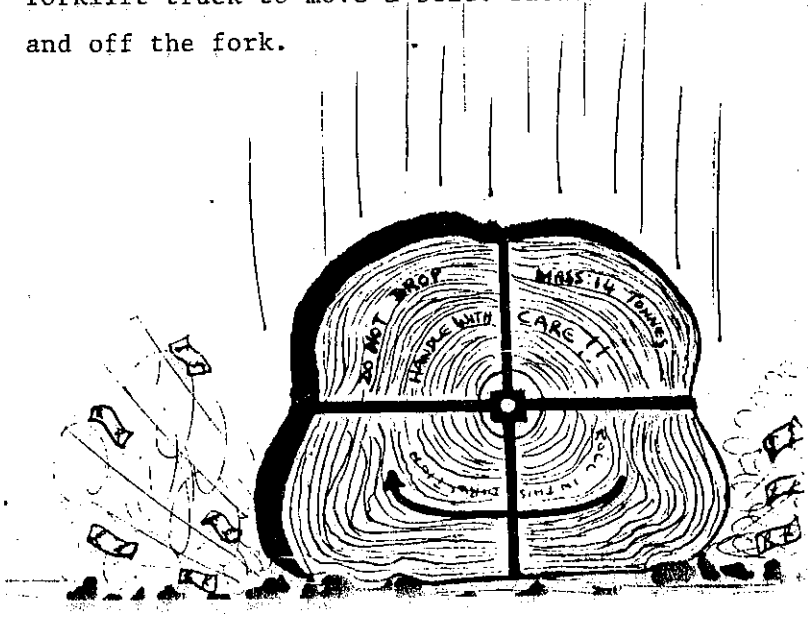


Many belts are being damaged by slings as a result of not using a spreader bar when hoisting the belting.

Would we off-load a luxury car to the same value in this fashion?



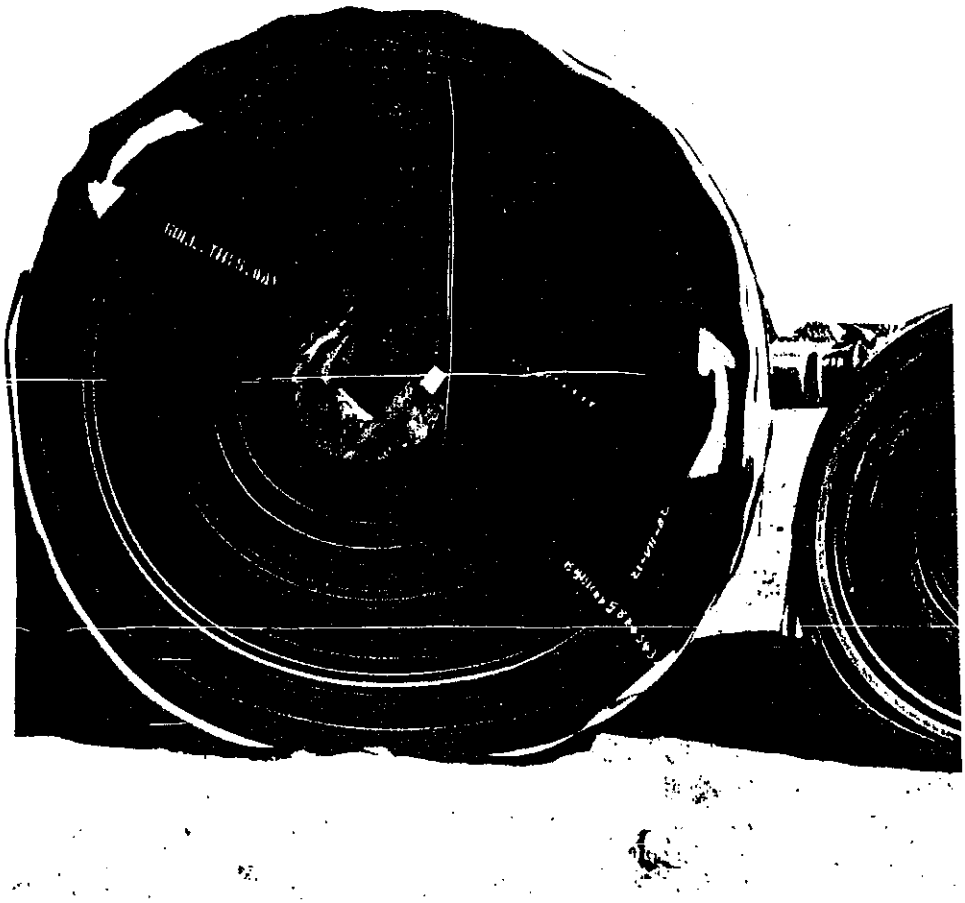
Many belts are damaged by forklift trucks when trying to force the fork under a heavy roll of belting. If you have to use forklift truck to move a belt. rather roll the belt onto and off the fork.



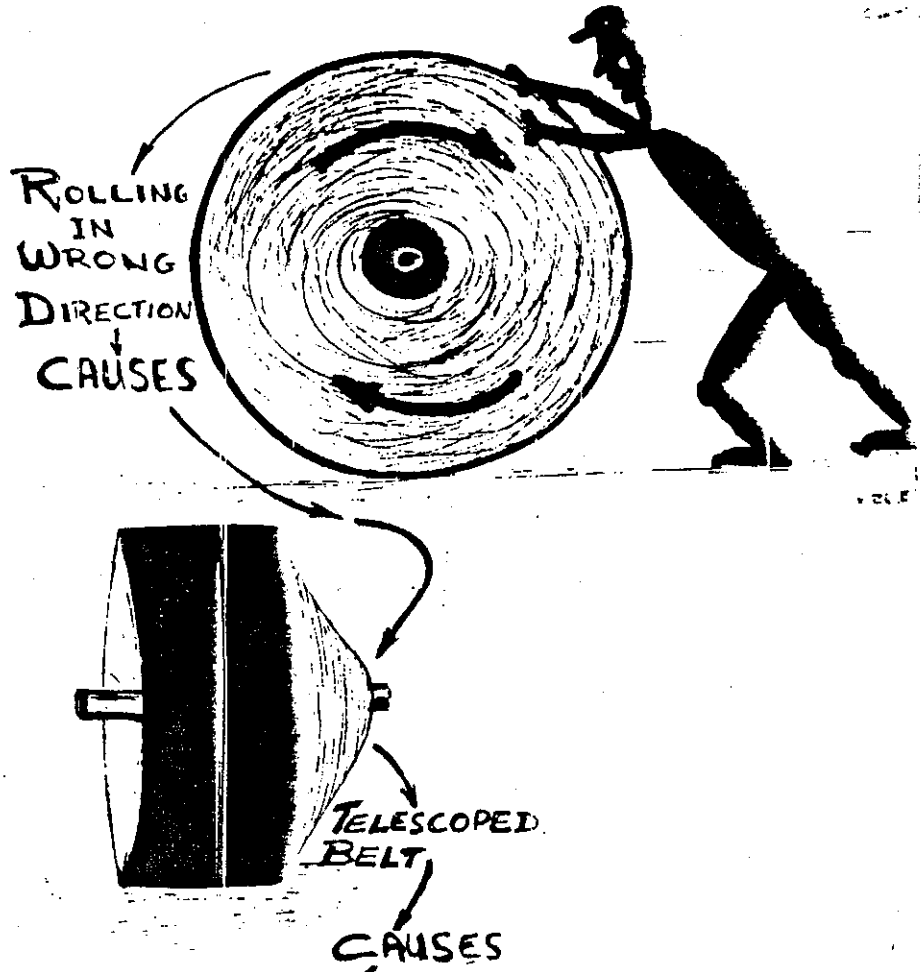
Rollsof belt should never be dropped from freight cars or trucks. Due to weight of the belt, dropping it from any such height can cause damage. The problem is : the damage cannot be seen. The rubber covers can stretch 300 or 400%, the carcass can't! The damaged carcass can therefore, not be seen without stripping the rubber covers off.

3.2 ROLLING

What will happen when a roll of belting is rolled in the wrong direction?



The belt will "telescope". If this happens and the belt is stored in this fashion, it may take a set and the belt will be bowed.

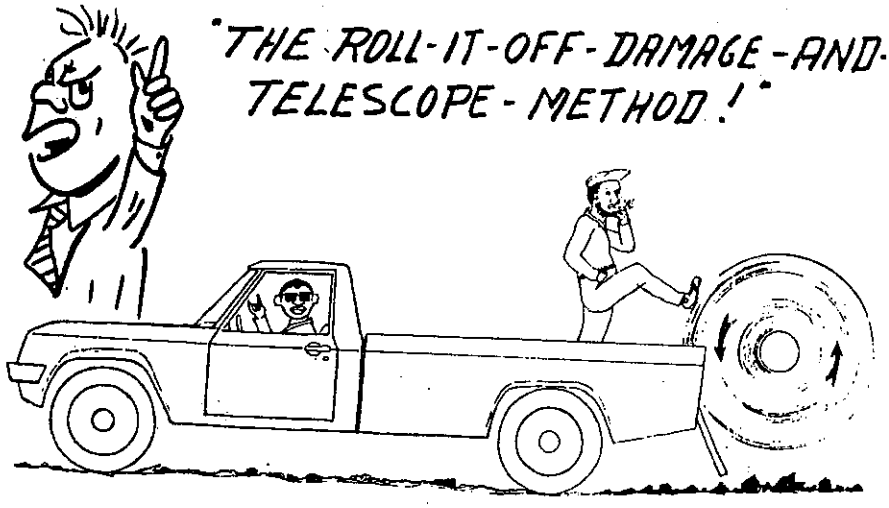


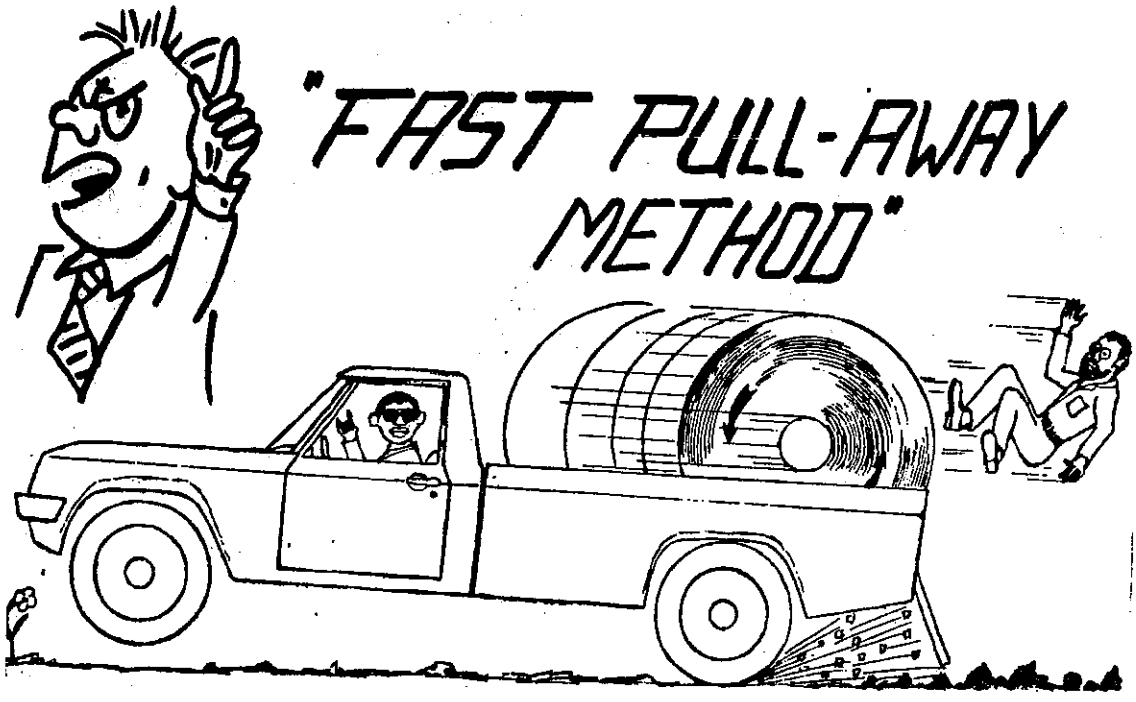
Therefore, always roll the belt in the direction indicated by the arrow on the side of the roll, even if it is being rolled for a short distance.

3.3 HOW NOT TO OFF-LOAD

Here are some other methods of off-loading belts - believe me it is being done.

The roll-it-off-damage-and-telescope- method! The people concerned do not even clear the ground where the belt lands of sharp stones and rubble.



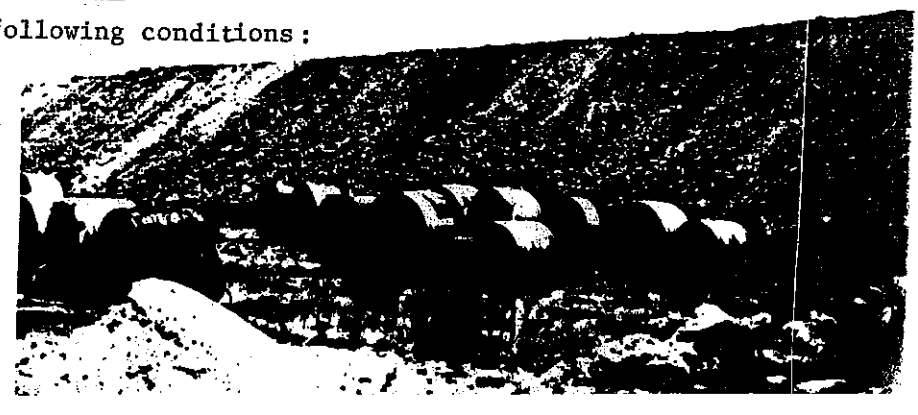


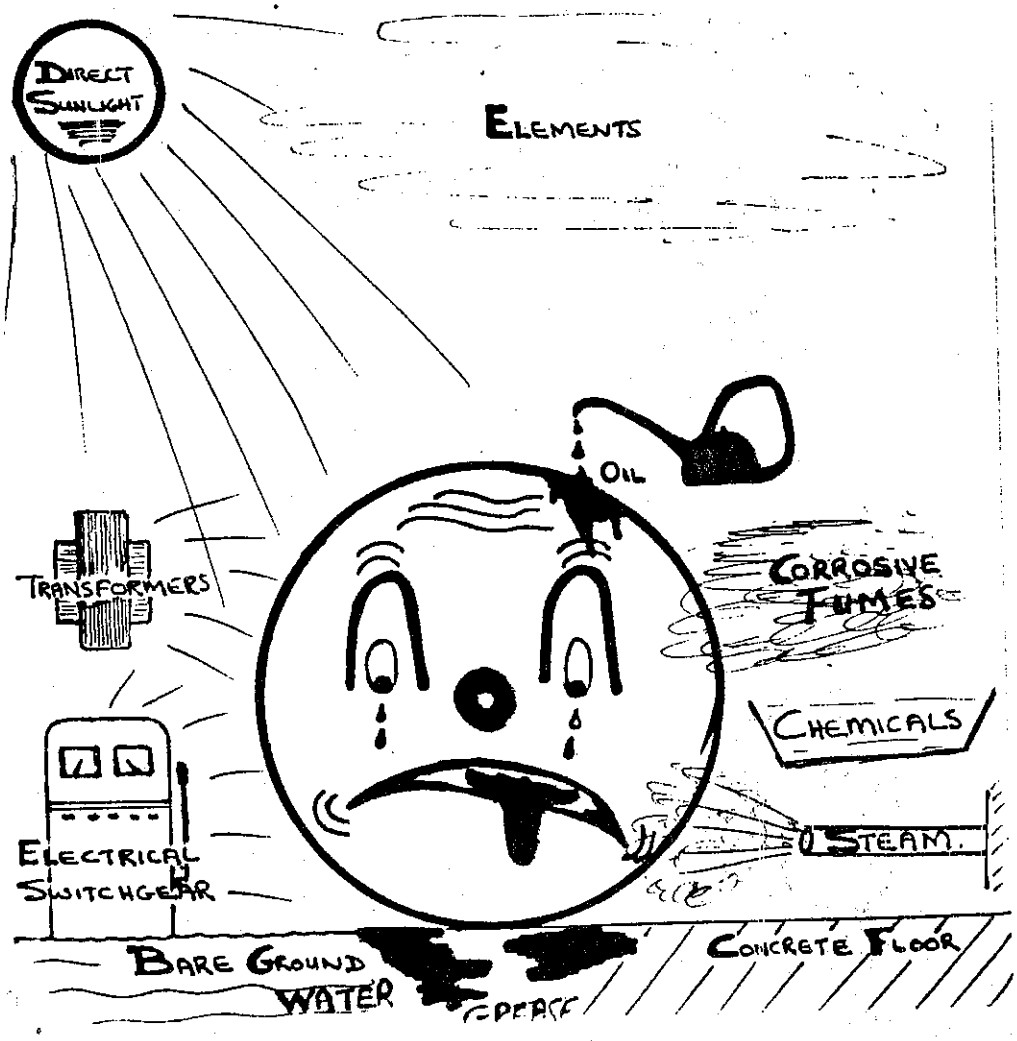
The fast-pull-away-damage-and-telescope method! Imagine off-loading a car or other expensive equipment in the same way.

4. STORAGE

4.1 FACTORS DETRIMENTAL

Avoid the following conditions:





Direct sunlight and storage near operational electrical switchgear - this causes fine ozone cracks in rubber.

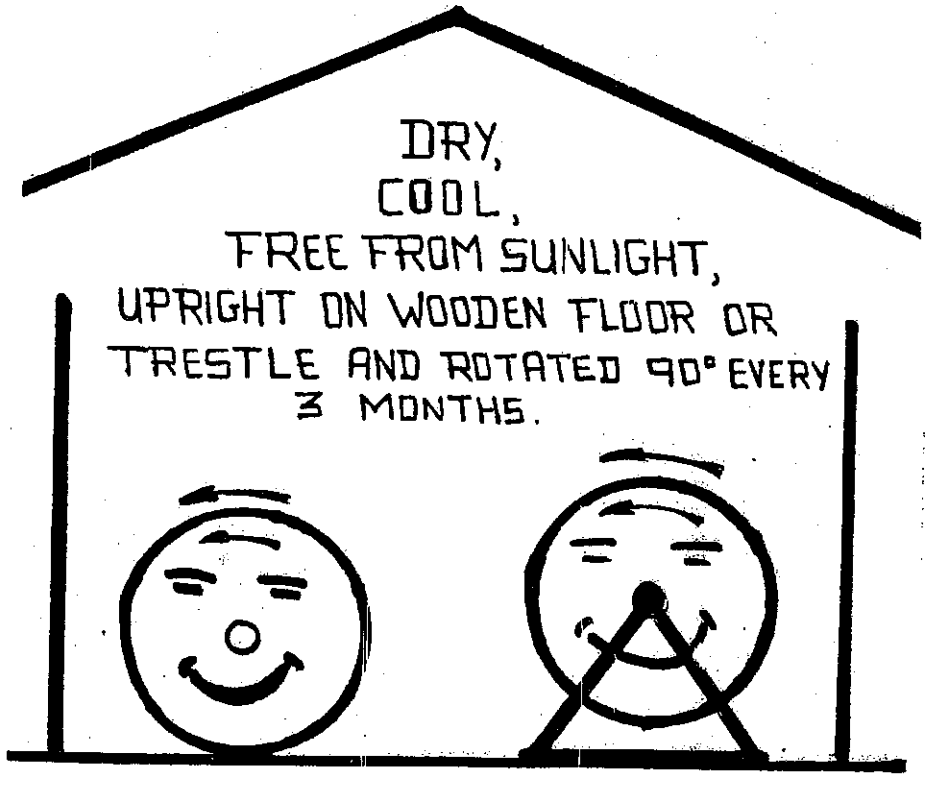
Oil causes rubber to swell.

Steam is detrimental and so are certain chemicals and fumes.

Under no condition should rolls of belt, especially raw edge or used, be laid flat on a concrete floor or ground. Moisture will shrink the fabric on one edge and the belt is liable to "bow".

A roll of belting tilted on one edge and stored in this fashion is also liable to "bow" once a set is taken.

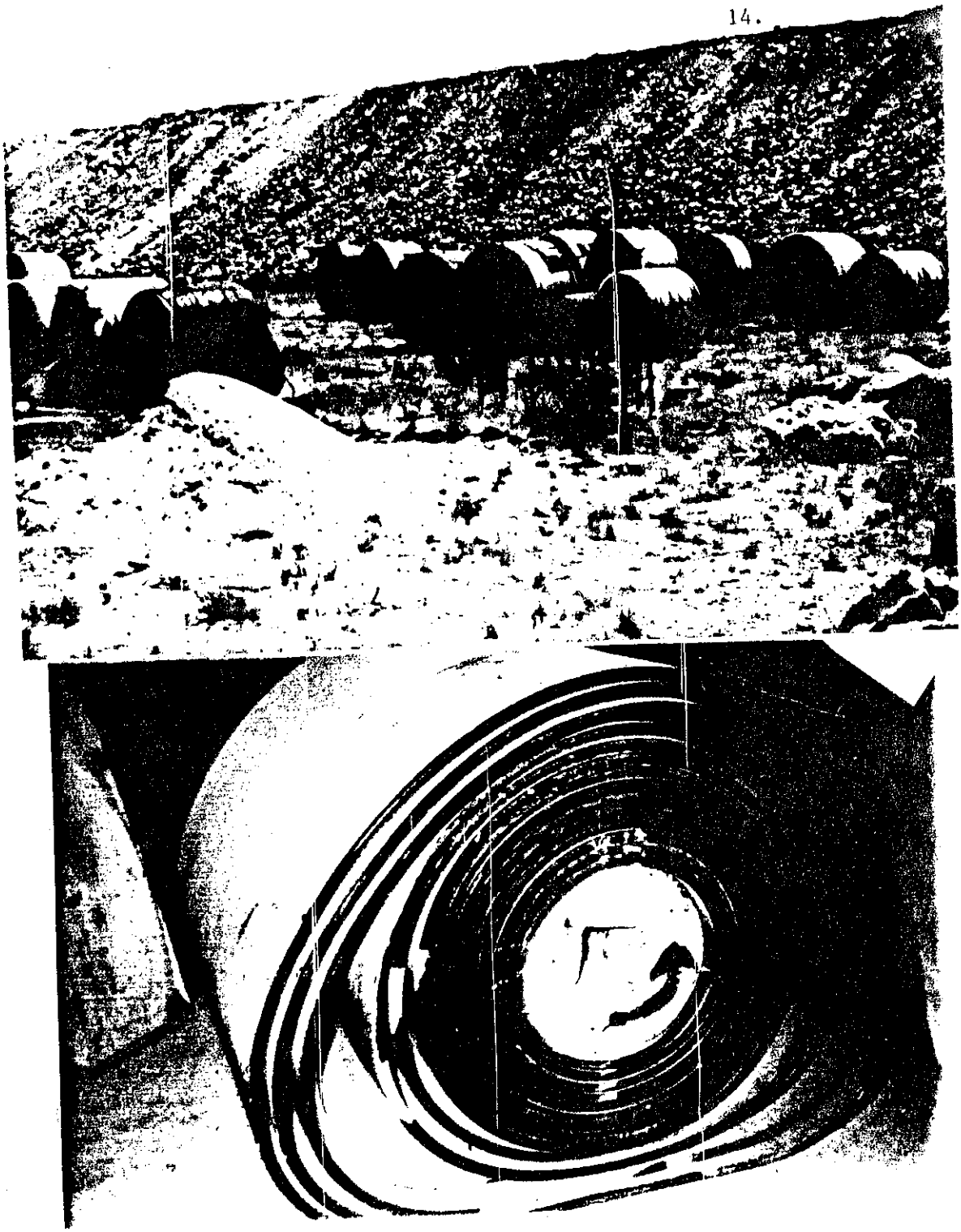
4.2 IDEAL STORAGE



Proper storage calls for the roll of belting suspended on a trestle or at least upright in factory package on a wooden floor, rotated 90° every 3 months (rotation in direction of arrow) - in a cool dry room, free from direct sunlight, steam pipes, oil, corrosive fumes and away from operational electrical equipment.

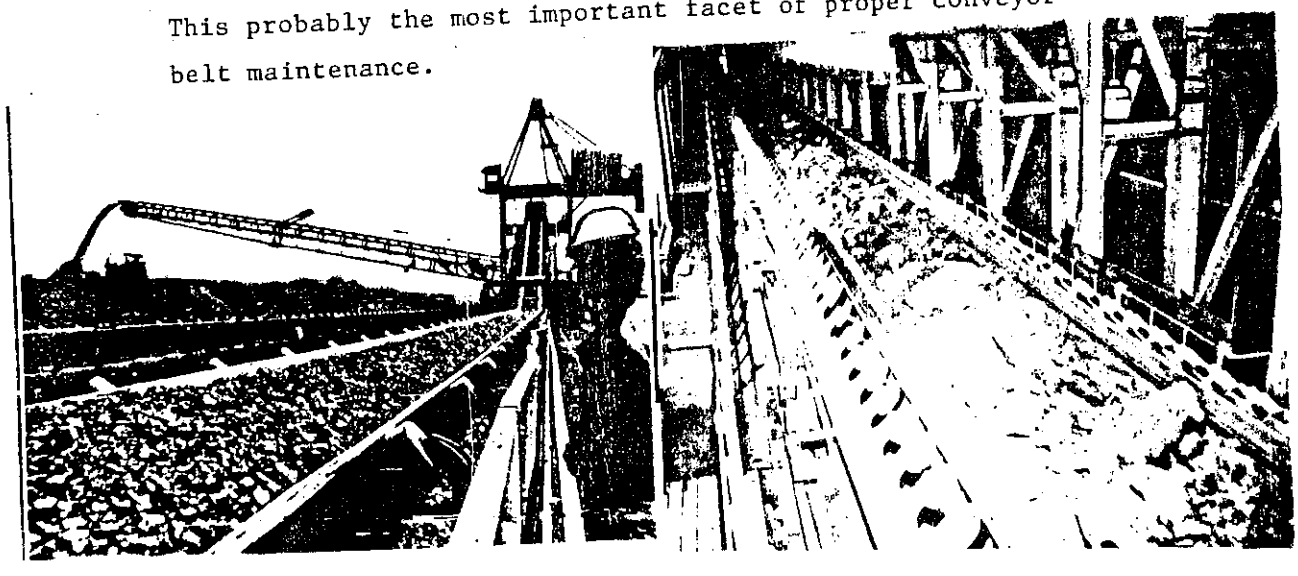
4.3 ALTERNATIVE STORAGE

A heavy duty tarpaulin should be seen as the minimum protection for a roll of belting stored in the open. Should not even this be available, then at least whitewash the roll of belting in order to deflect some of the rays of the sun.

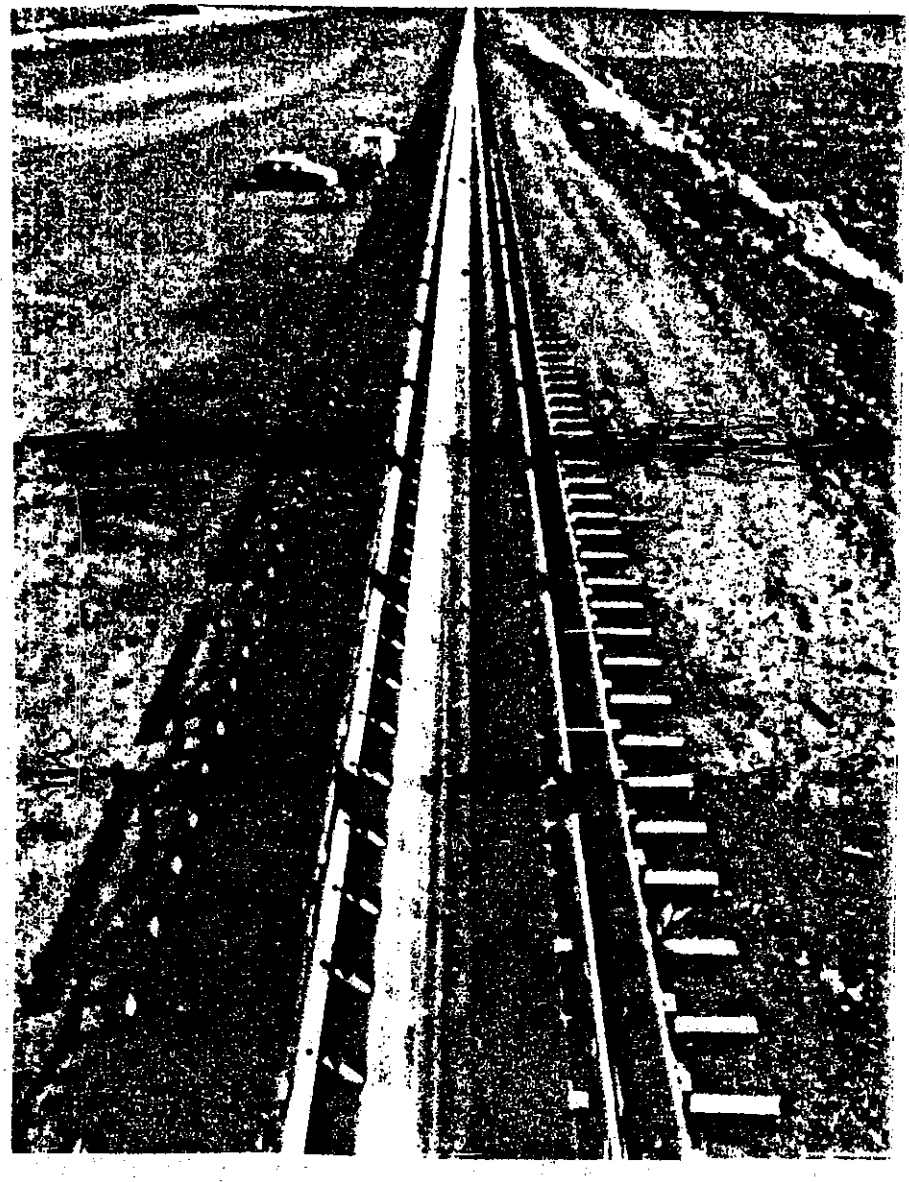


5. TRAINING THE CONVEYOR BELT

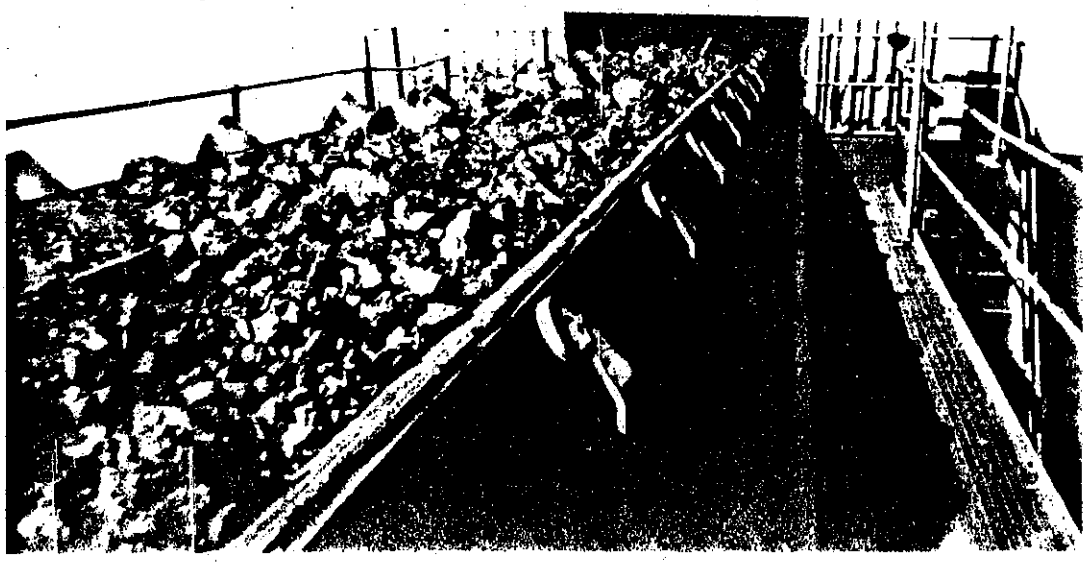
This probably the most important facet of proper conveyor belt maintenance.



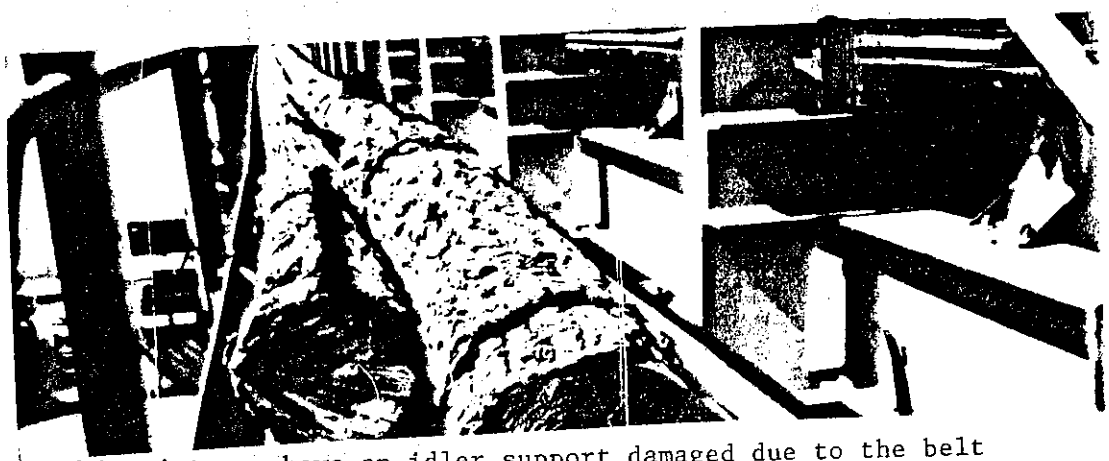
Training the belt is the process of adjusting idlers, pulleys and loading conditions in a manner which will correct any tendency of the belt to run other than centrally.



All too often expensive conveyor belts are allowed to run itself to destruction against the steelwork, as can be seen in this picture.



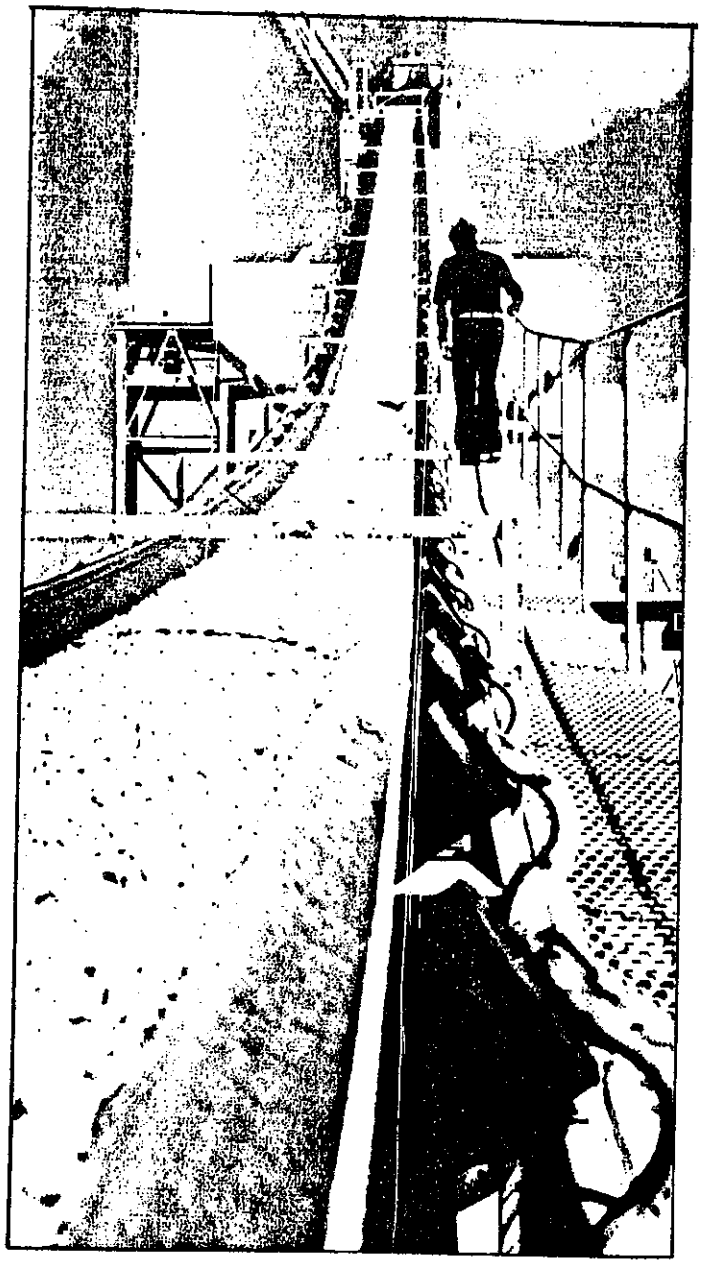
How long would a conveyor have to run in a detrained state to cut this deep into a steel member? Cut edge belts are less susceptible to damage when run into the structure. Edge caps are not an integral part of the belt and tends to rip off, under these conditions, and normally pieces of the top and bottom cover are also ripped off in the process.



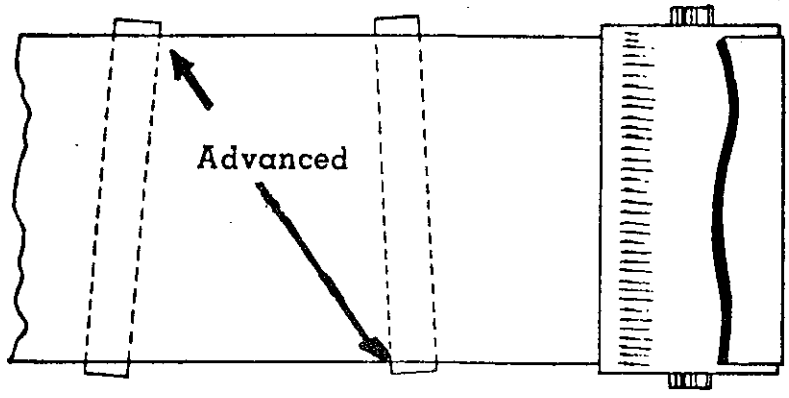
This picture shows an idler support damaged due to the belt rubbing against it. Instead of training the belt, a steel plate was welded over the support to give the belt somethting new to eat away!

5.1 MINIMUM SHIFTING OF IDLERS

Always remember that conveyor belts are hand built and each one may react differently. Don't expect the new belt you've pulled in, to train perfectly on the idlers set for the previous belt.



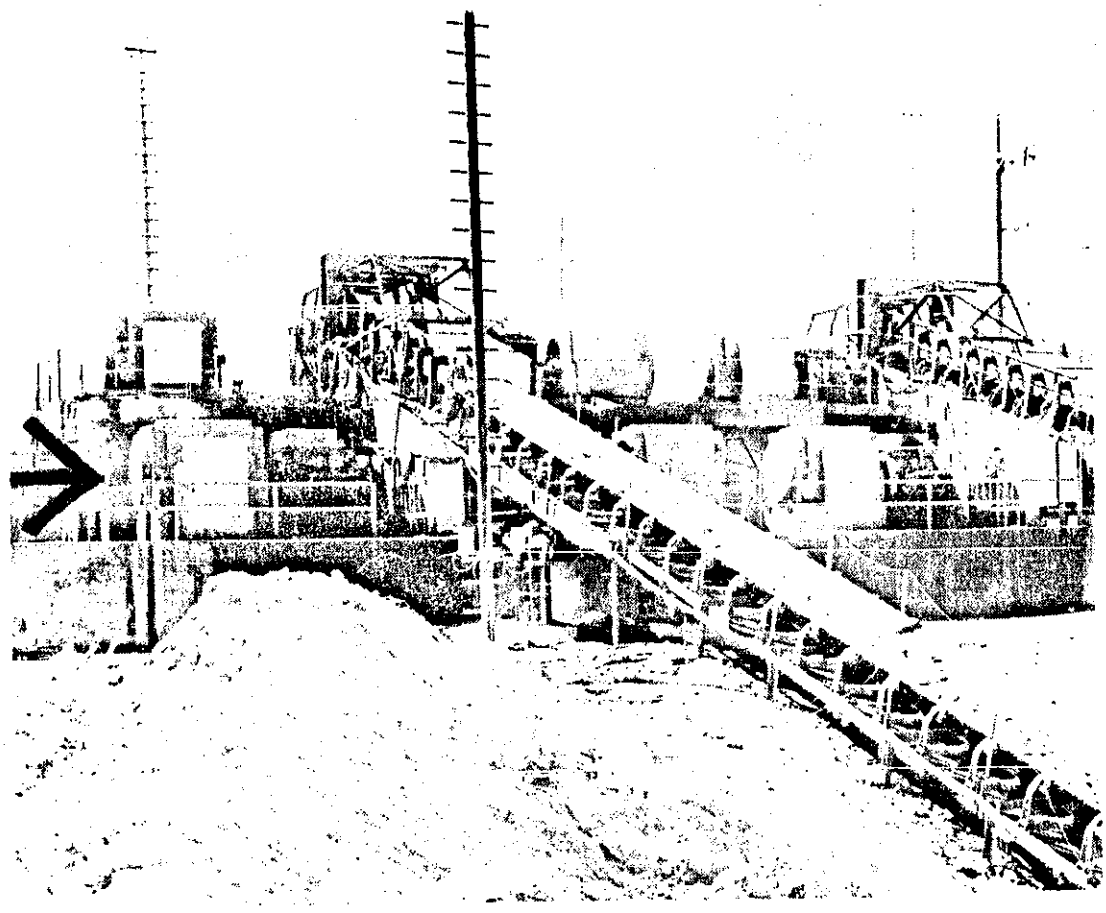
Rather start off with all the idlers and pulleys in line, level and square to the path of the belt. You may feel that this would be unnecessary and time wasted, but let me assure you that it could pay big dividends in increased belt cover wear, decreased (or prevention of) belt edge damage plus decreased running costs, due to less power consumed to drive belt.



Idlers knocked in all directions in an effort to train a belt causes undue friction which results in unnecessary belt cover wear and more power consumed to drive the belt.

5.2 EXCESS POWER CONSUMED

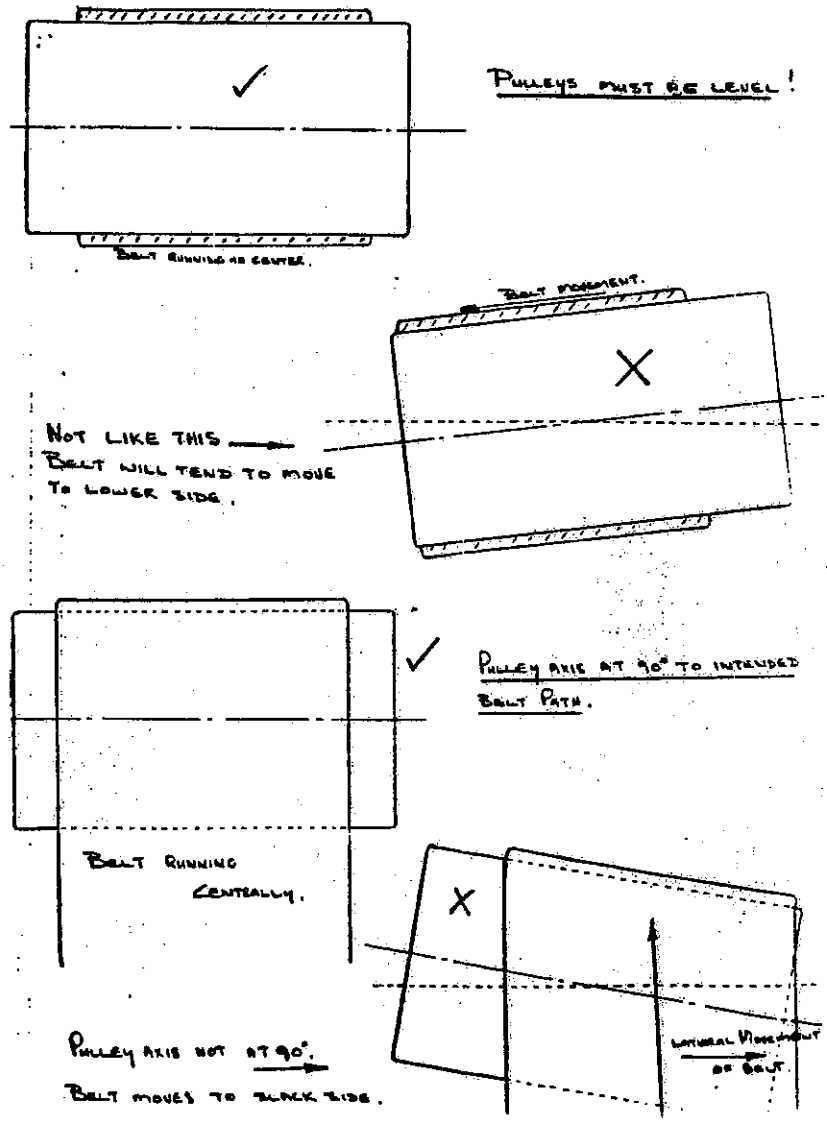
Many belt men talk about the damage that is done to the belting due to belt edges being rubbed against obstructions.



They never mention the tremendous amount of power that it takes to drag even a small stretch of belt length along a stringer. The belt edges can take quite a bit of this sort of abuse, but the extra power consumed is not only costly, but also overloads the motor and overstresses the belting above that for which it was supposedly designed.

So rather start off with all the idlers in line, level and square to path of belt for big savings.

5.3 PULLEYS

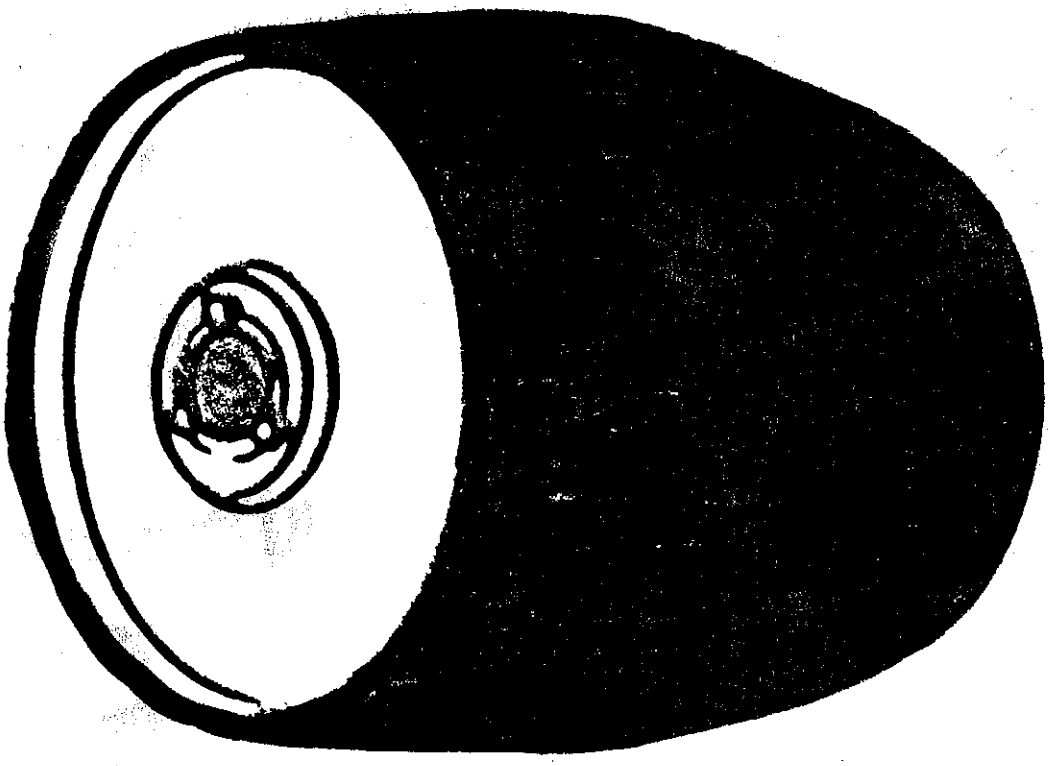


Equally important :

All pulleys should be level and with their axis at 90° to the intended path of the belt. They should be kept that way and not shifted as a means of training with the exception that snub pulleys may have their axis shifted when other means of training have provided insufficient correction. Pulleys with their axis at other than 90° to the belt path will lead the belt in the direction of the edge of the belt which first contacts the mis-aligned pulley. When pulleys are not level the belt tends to run to the low side. This is contrary to

the old "rule of thumb" statement that a belt runs to the "high" side of the pulley. When combinations of these two occur, the one having the stronger influence will become evident in the belt performance. Pulleys out of level and/or square also causes the pulley or pulley lagging to wear unevenly. So if you see a pulley with its lagging worn away on one side only - check whether it is level and square.

5.4 CROWNING OF PULLEYS



Relatively little steering effect is obtained from the crown of conveyor pulleys. Crown is most effective when there is a long unsupported span of belting, (approximately four times belt width) approaching the pulley. As this is not possible on the conveyor carrying side, head pulley crowning is relatively ineffective and is not worth the lateral mal-

distribution of tension it produces in the belt.

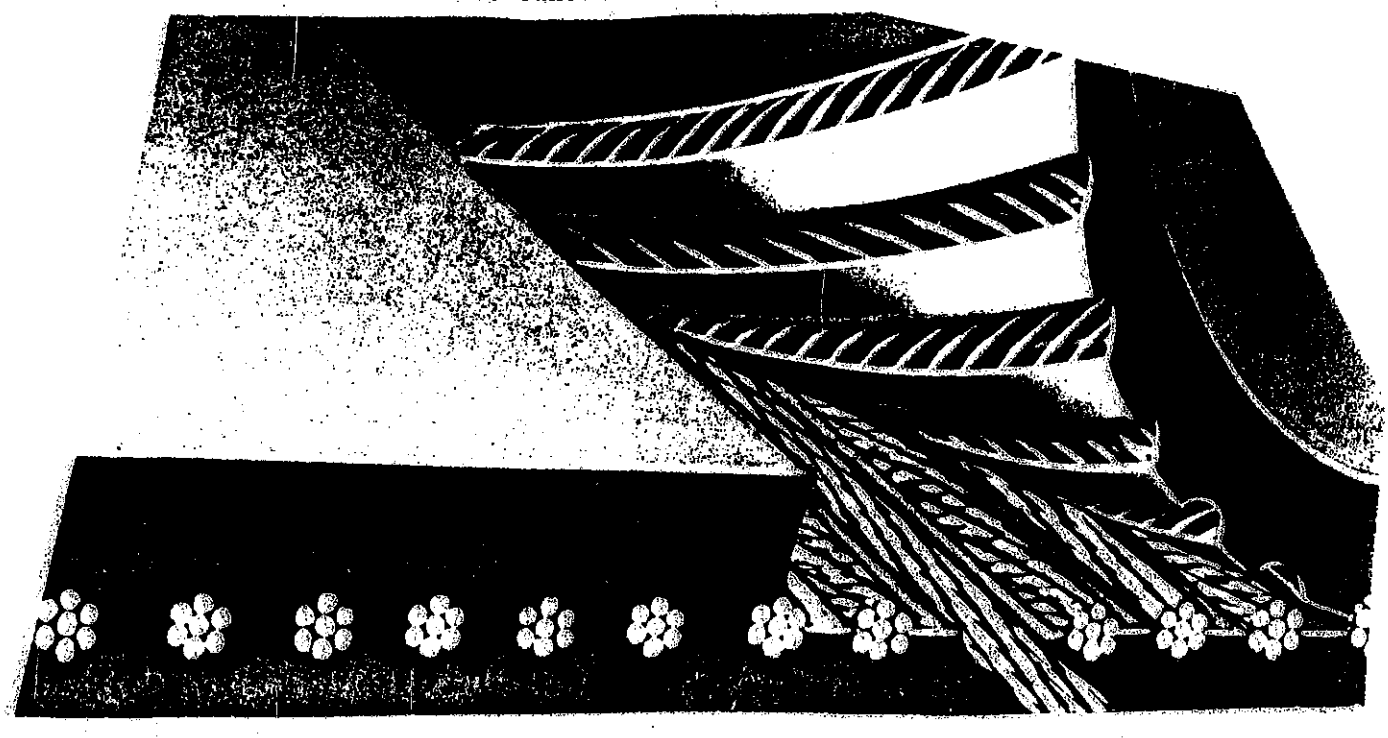
Tail pulleys may have such an unsupported span of belt approaching them and crowning may help except when they are at points of high belt tension. The greatest advantage here is that the crown, in some degree, assists in centering the belt as it passes beneath the loading point which is necessary for good loading. Take-up pulleys are sometimes crowned to take care of any slight mis-alignment which occurs in the take-up carriage as it shifts position. Consult the Goodyear "Handbook of Belting" for a more detailed discussion of pulley crown.

A pulley crown of 10mm per metre of face width results in an increase in pulley diameter (at the centre) of 10mm above the edge diameter for each metre of face width; i.e. a 1m wide pulley will be 10mm larger in diameter at the centre than at the edges.

The practice of increasing crown with pulley width is wrong in certain respects. It is more proper to increase crown with diameter and hold it constant for all widths.

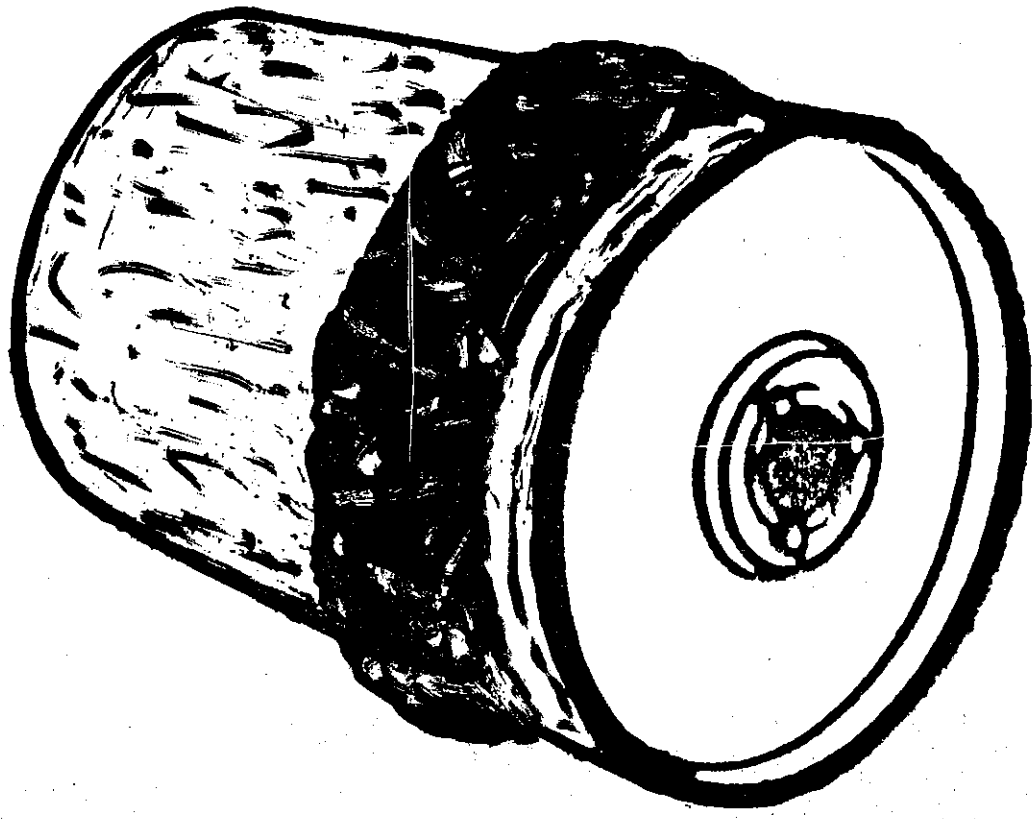
On a system where steelcord conveyor belting is used, pulley crowning is an absolute no-go. As far as mal-distribution of tension is concerned, steelcord belting is <u>not</u> as forgiving as fabric belting.

The cords in a steelcord belt are designed to share the load equally, a single cord in the belt <u>cannot</u> take the full strain on its own!



It is our experience that pulley crowning can cause splices to fail prematurely - especially mechanical fastened joints which tend to start tearing out in the centre, corresponding with the crown/s, and then working toward both edges of the belt fairly rapidly.

5.5 MATERIAL BUILD-UP ON EQUIMENT

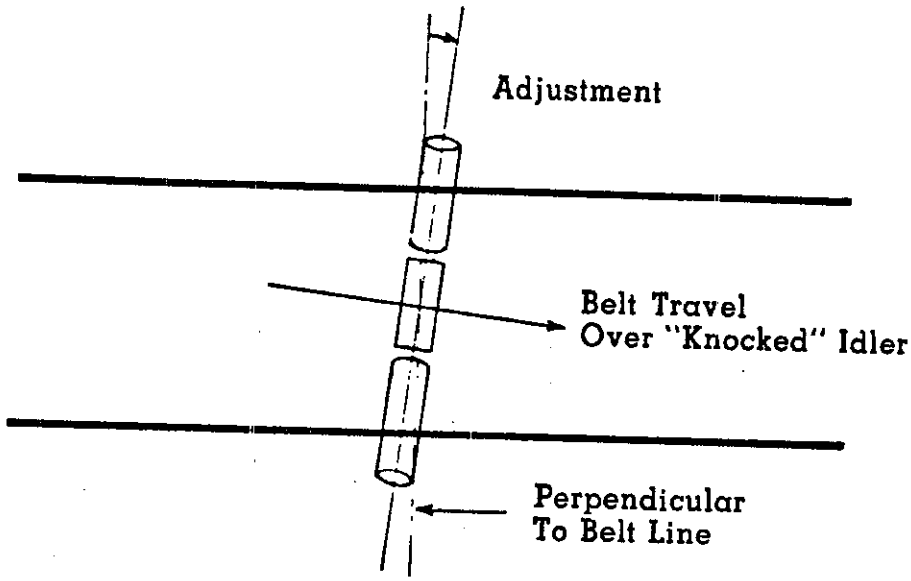


Special care must be exercised to keep return rolls, snubs and other pulleys clean. Build-up of material on this equipment has a destructive effect upon training, with the result that a properly trained belt may run against the structure and damage itself.

Remember : Material build-up on pulleys and idlers acts like a crown. The belt will try to centre over this "crown"

and since this build-up is not necessarily in the centre of the pulley face, it could cause the belt to detrain. It also causes mal-distribution of tension in the belt which is detremental in itself and more so with steelcord belting.

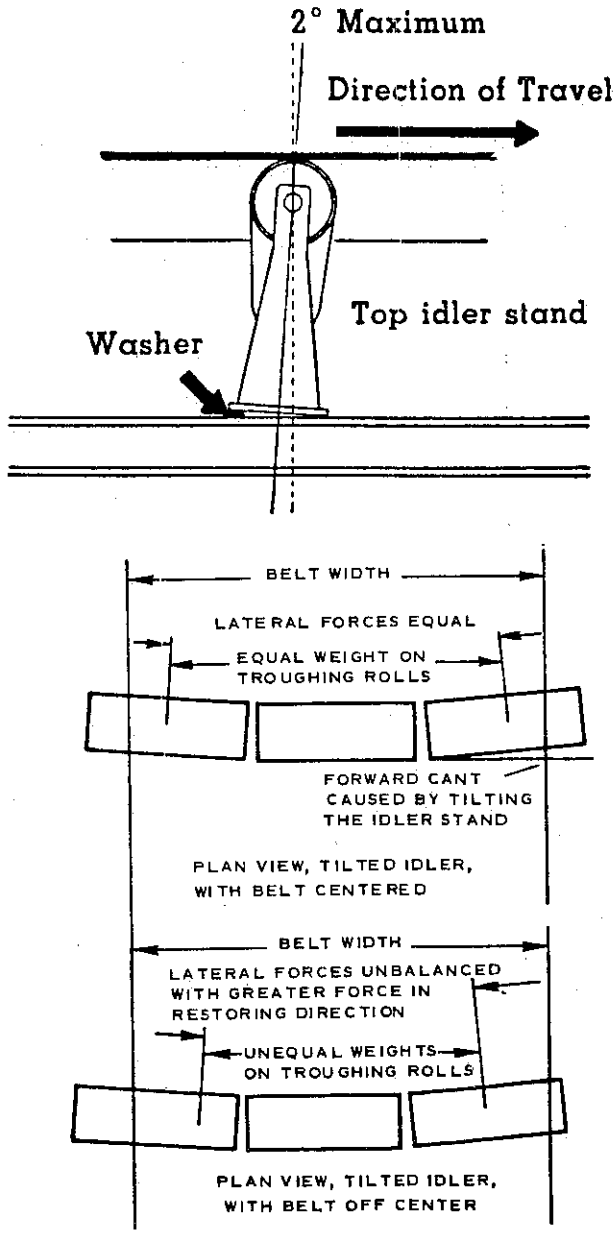
5.6 CARRYING IDLERS



Training the belt with the troughing idlers is accomplished in two ways. Shifting the idler axis with respect to the path of the belt, commonly known as "knocking idlers", is effective where the entire belt runs to one side along some portions of the conveyor. The belt can be centered by "knocking" ahead (in the direction of belt travel) the end of the idler to which the belt runs.

Obviously such idler shifting is effective for only one direction of belt travel. If the belt is reversed, a shifted idler, corrective in one direction, is mis-directive in the other. Hence reversing belts should have all idlers squared up and left that way. Any correction required can be provided with self-aligning idlers designed for reversing operation. Not all self-aligners are of this type, as some work in one direction only.

Tilting the troughing idler forward (not over two degrees) in the direction of belt travel produces a self-aligning effect. The idlers may be tilted in this manner by shimming the rear leg of the idler stand. Here again this method is not satisfactory where belts may be reversing.

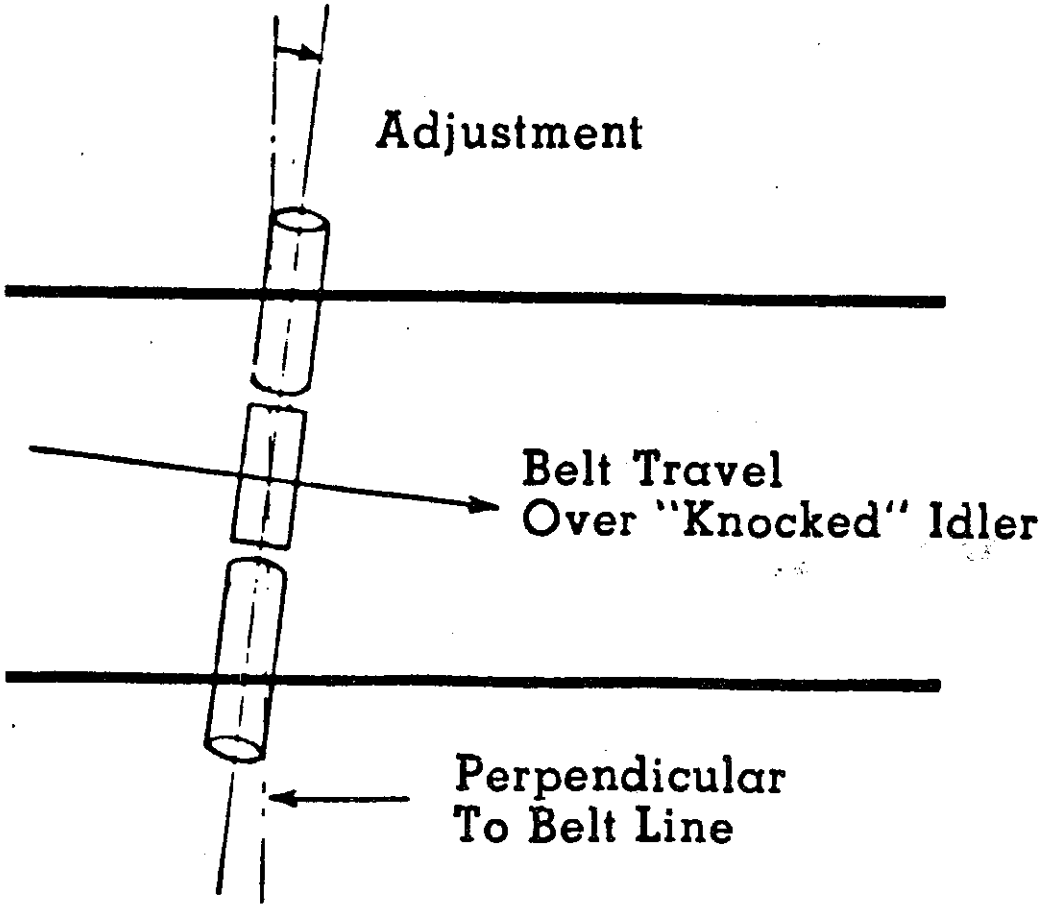


- Effect of Tilted Troughing Idler

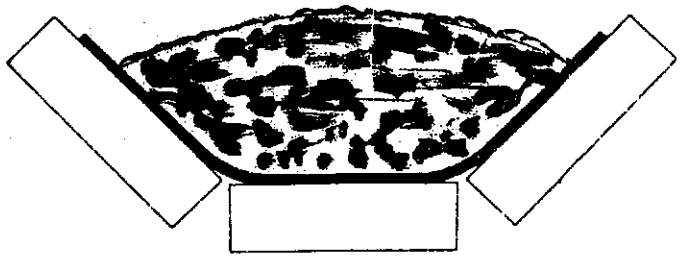
This method has an advantage over "knocking idlers" in that it will correct for movement of the belt to either side of the idler, hence is useful for training erratic belts. It has the disadvantage of encouraging accelerated pulley cover wear due to increased friction on the troughing rolls. It should therefore be used as sparingly as possible - especially on the higher angle troughing idlers

5.7 RETURN IDLERS

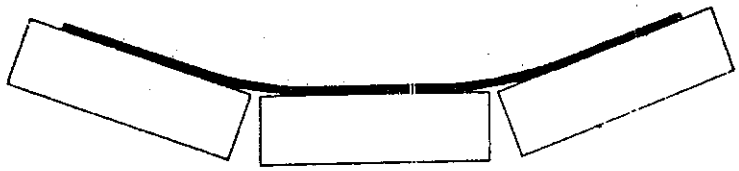
Return idlers, being flat, provide no self-aligning influence as in the case of tilted troughing idlers. However, by shifting their axis (knocking) with respect to the path of the belt, the return roll can be used to provide a constant corrective effect in one direction. As in the case of troughing rolls, the end of the roll toward which the belt is shifting should be moved longitudinally in the direction of return belt travel to provide correction.



The simplest method to train a belt correctly is to trough the belt sufficiently on the top and bottom strand e.g. top strand troughing minimum 20°, bottom strand troughing minimum 10°.

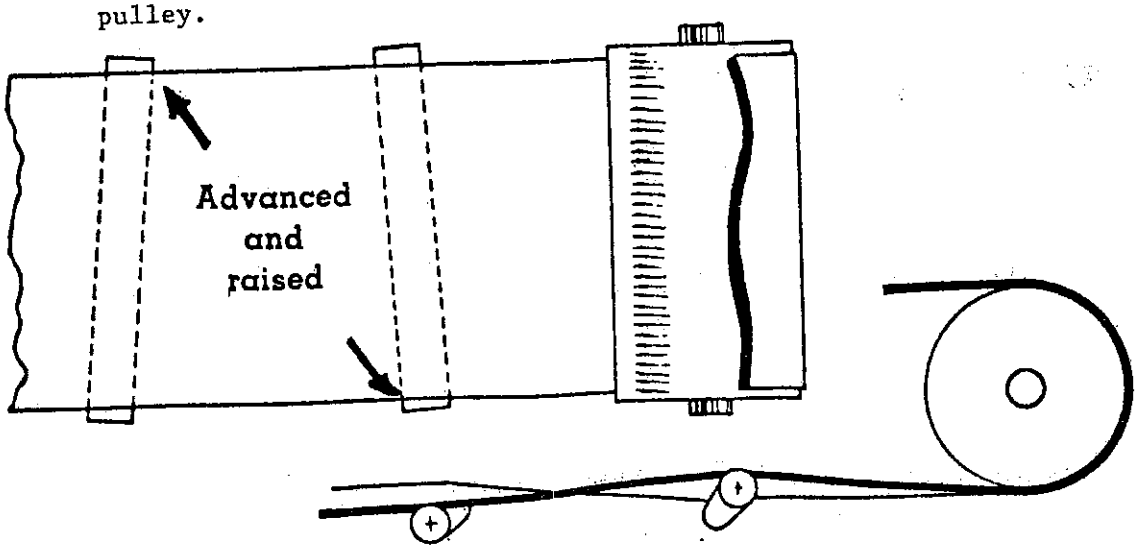


TOP

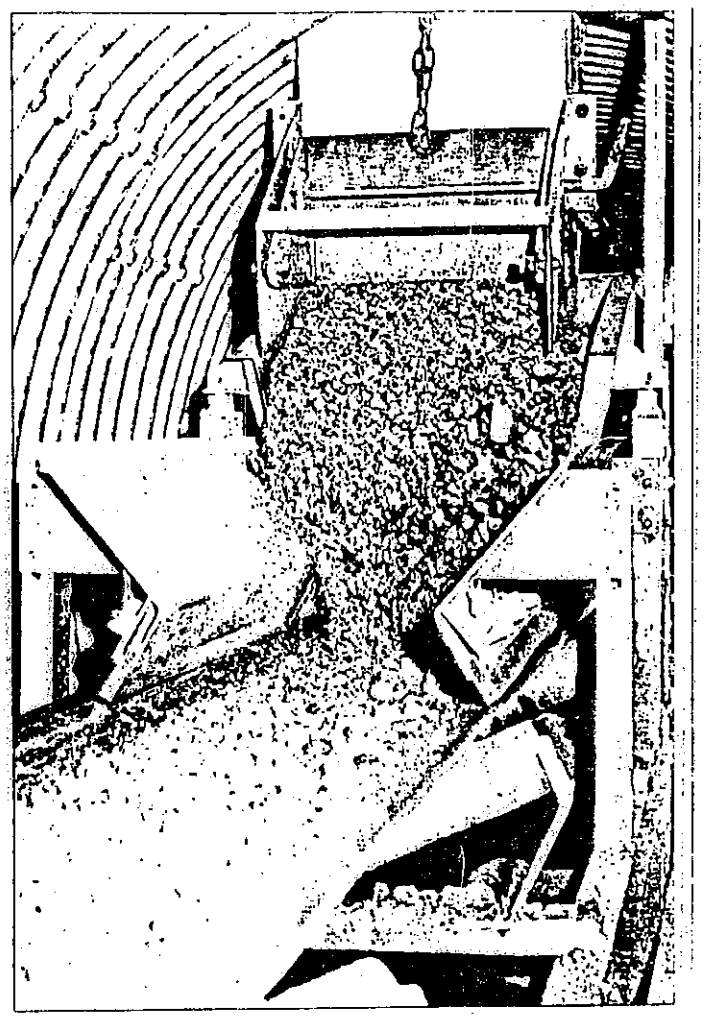


BOTTOM

A further aid to centering the belt as it approaches the tail pulley may be had by slightly advancing and raising the alternate ends of the return rolls nearest the tail pulley.

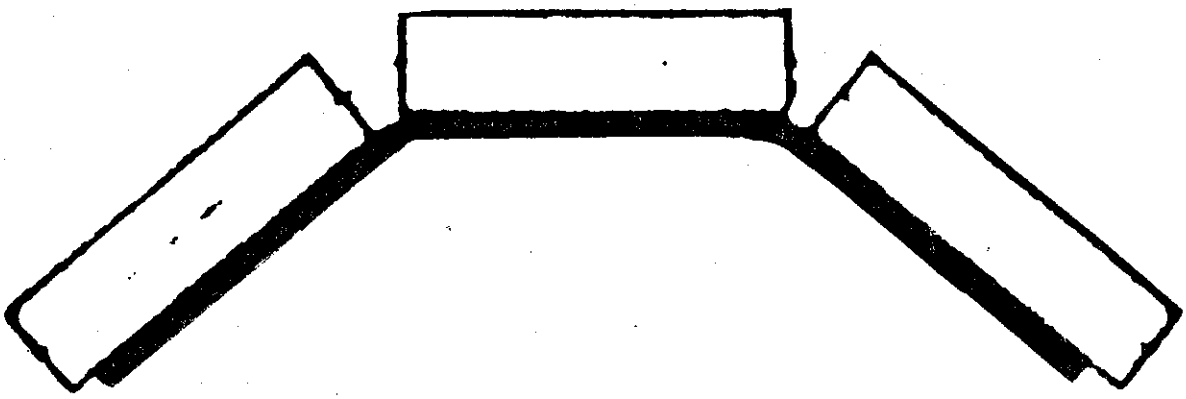


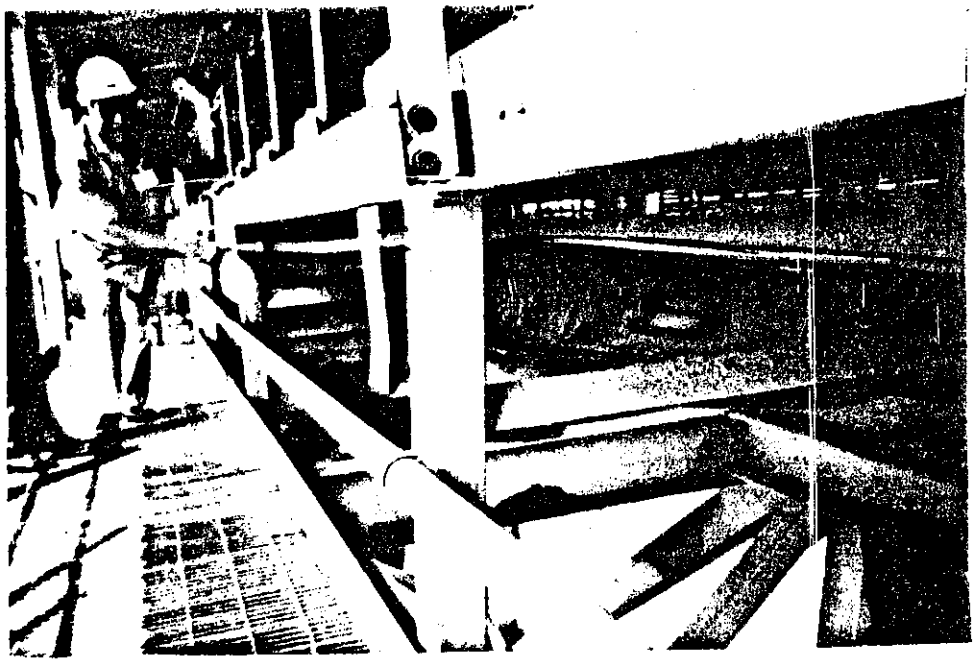
Another aid in centering the belt, especially before the tail pulley, in order to centre it under the loading chute, is to install inverted - V return idlers.



Two roll inverted - V - return idler.

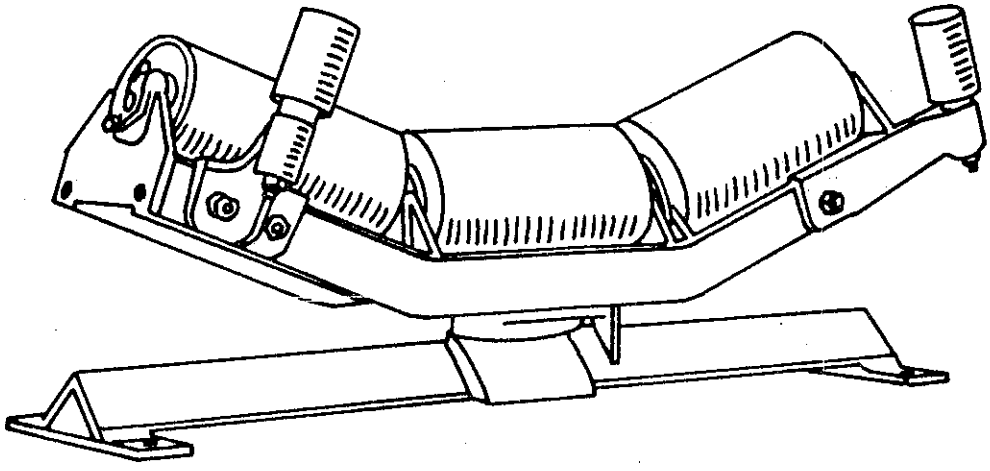
Three roll inverted - V - return idler.





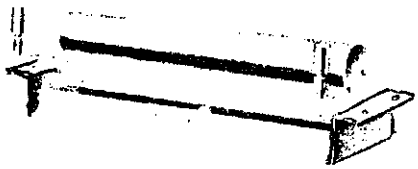
It would be wise to design your conveyor framework in such a way that the return strand could be seen without going on hands and knees and allowing for belt wander without rubbing against structure or brackets.

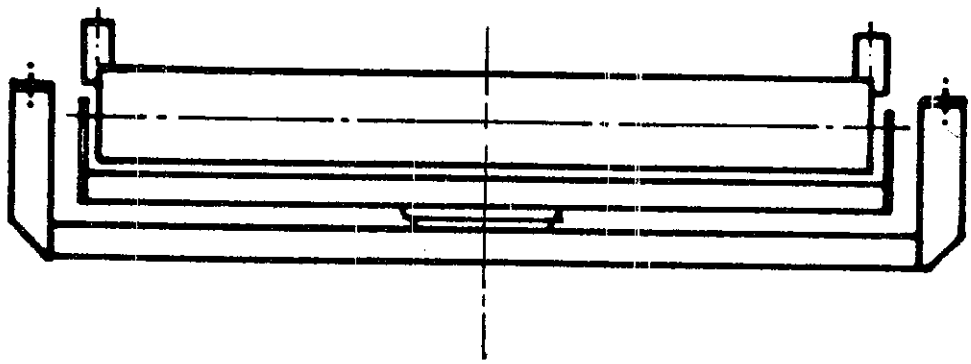
5.7 SELF ALIGNING IDLERS

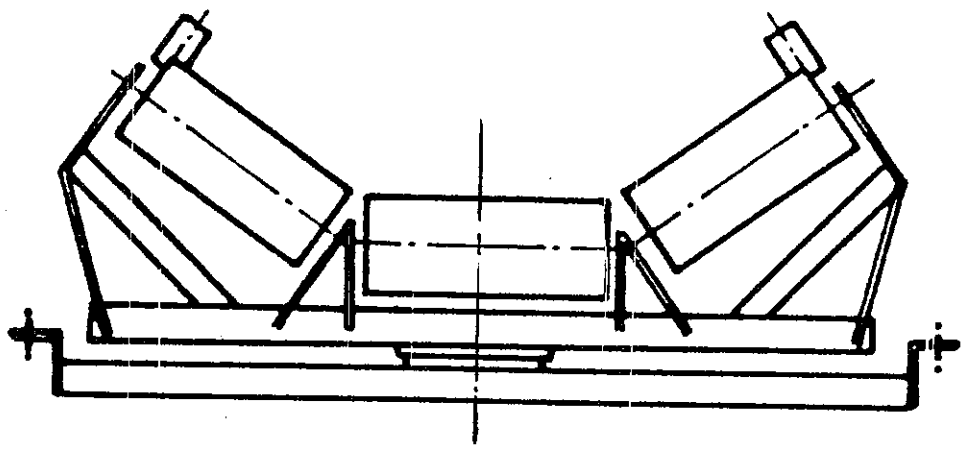


Special self-aligning troughing idlers are commonly used in place of, or in addition to the tilting idlers to provide a self-aligning influence.

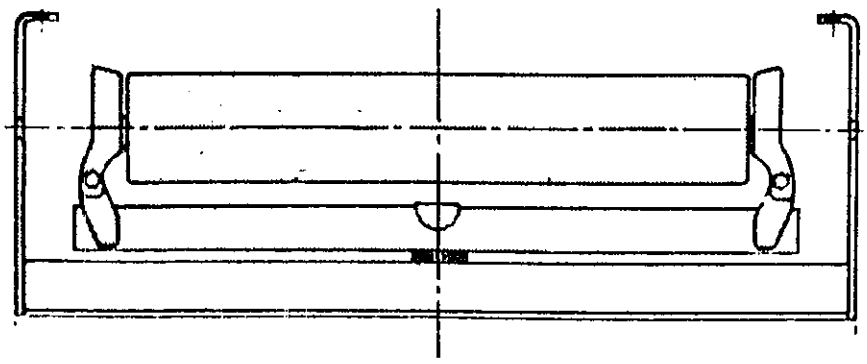
Self-aligning return rolls operating on the centre pivot method also are used for automatically controlling the centering of the belt's return run.



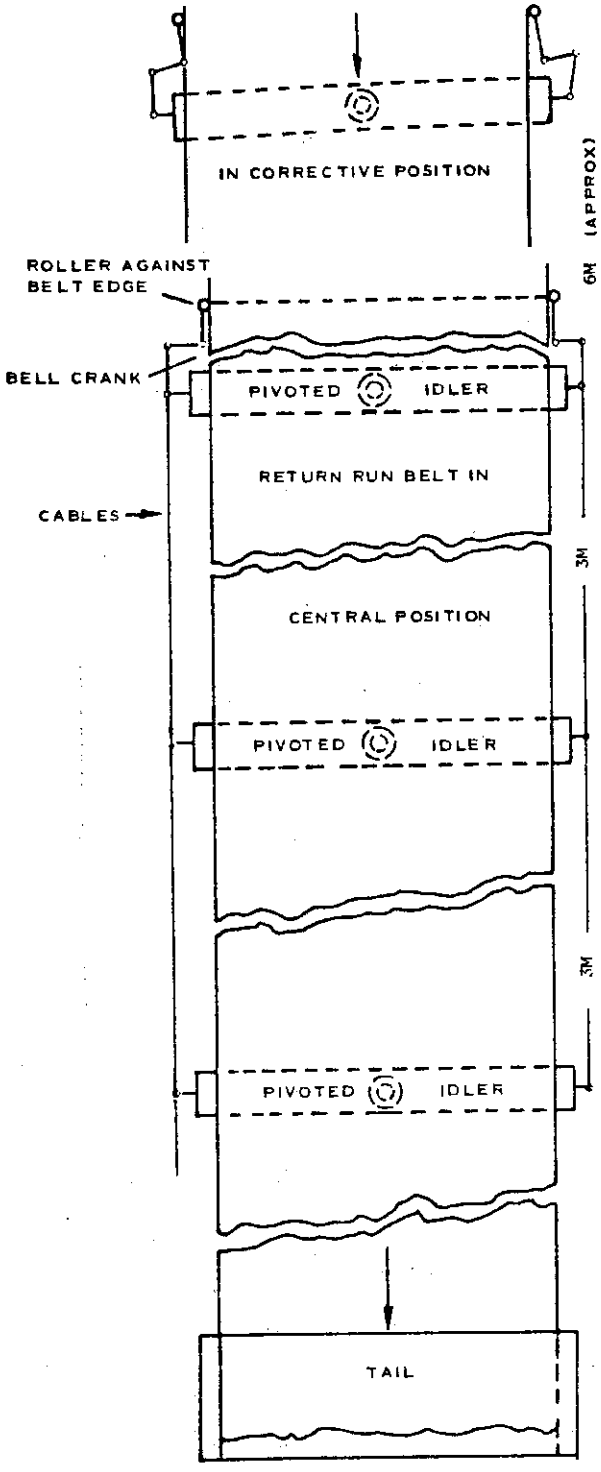




Should training idlers be required, such designs are to be preferred which cannot damage the belt edges (e.g. vertical side guide idlers).



5.8.1. SPECIAL ALIGNING DEVICES



Return Belt Centering Device

In some cases, special aligning devices have been provided on the return run just ahead of the tail pulley to ensure that the belt is brought centrally around the tail pulley and thus is loaded centrally. These devices usually consist of a group of three self-aligning return rolls connected with light cables so that they swing about their pivots

in unison. In addition they are provided with mechanical help in swinging so that they give a more prompt and greater corrective effect.

In some cases, this mechanical help in swinging comes from the edge of the belt at a point preceding the self-aligning idlers. This mechanical help is accomplished by a roller, bearing lightly against the belt edge, that transmits lateral belt movement through a bell crank arrangement and small cables to the pivoted idlers. Another way of doing this is to take the indication from the belt edges with light relays that open and close the circuit of a small motor, which then swings the pivoted idlers in a corrective direction.

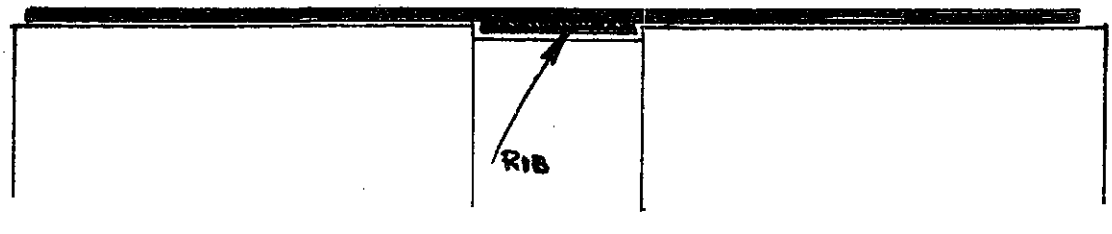
5.8.2 ASSURING EFFECTIVENESS OF TRAINING ROLLS

Normally, extra pressure is desired on self-aligning idlers and, in some cases, on standard idlers where strong training influence is required. One way to accomplish this is to raise such idlers above the line of adjacent idlers. Idlers or bend pulleys on convex (hump) curves along the return side have extra pressure due to component of the belt tension and are therefore effective training locations. Carrying side self aligners should not be located on a convex curve since their elevated positions can promote idler juncture failure of the carcass.

5.8.3. SPACING OF SELF-ALIGNING IDLERS

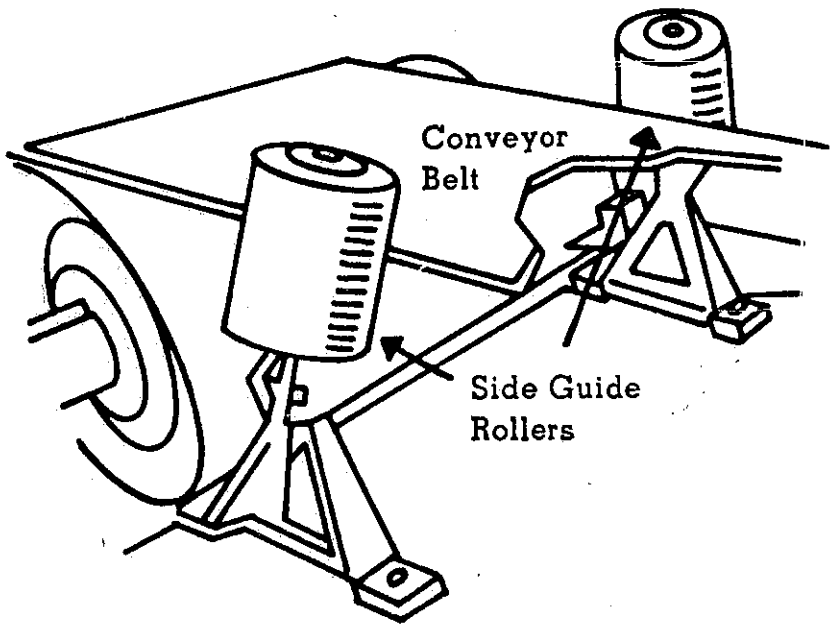
If everything about the conveyor is aligned and leveled and if the belt is troughing and straight, no self-aligning idlers are needed. Rarely are these imperfections wholly absent, however, and thus most conveyors need self-aligning idlers. The troughing idlers often will provide adequate training on the carrying side, but all conveyors should have self-aligners on the return, especially in the area preceding the tail pulley.

5.8.4 GUIDING DEVICES ON BELT



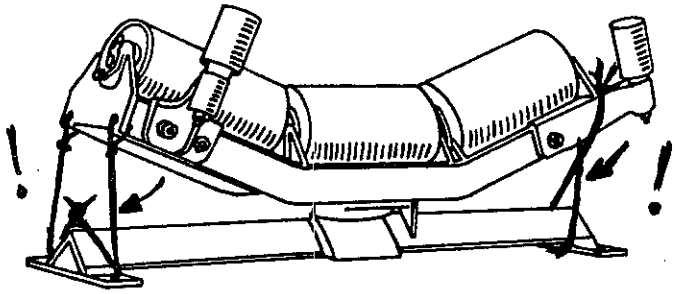
Some conveyors impossible to train otherwise are guided by a rib, molded centrally along the underside of the belt, that runs loosely in a groove in the idlers and pulleys. This guide is not a practical or a necessary means on long conveyors that can be trained otherwise. It is a last resort where out-of-level operation and off-centre loading defeat ordinary training methods and for extremely short, wide conveyors that do not respond to other means of training.

5.8.5 SIDE GUIDE ROLLERS



Guides of this type are not recommended for use in making belts run straight. They may be used to assist in training the belt initially to prevent it from running off the pulleys and damaging itself against the structure of the conveyor system. They may also be used to afford the same sort of

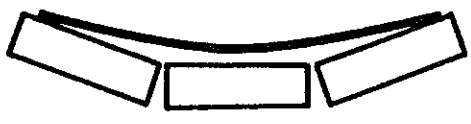
protection to the belt as an emergency measure, provided that they do not touch the belt edge when it is running normally. If they bear on the belt continually, even though free to roll, they tend to wear off the belt edge and eventually cause ply separation along the edge. Side guide rollers should not be located so as to bear against the belt edge once the belt is actually on the pulley.



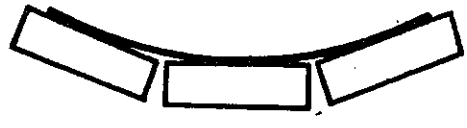
In virtually all the Plants we have visited, we have found self-aligning idlers which cannot pivot due to rust or dirt or because it was fastened to the structure by means of a piece of wire.

If a self-aligning idler is not functioning correctly, rather remove it completely before it damages the belt, or repair it immediately.

5. 9 BELT LATERAL STIFFNESS



Incorrect Troughing



Correct Troughing

A belt having extreme lateral stiffness relative to its width, will be more difficult to train and will behave

erratic, due to its lack of contact with the centre roll of the carrying idler. Recognition of this fact enables the user to take extra precaution and, if necessary, load the belt during training to improve its steerability. Observation of troughability design limitations will normally avoid this trouble.

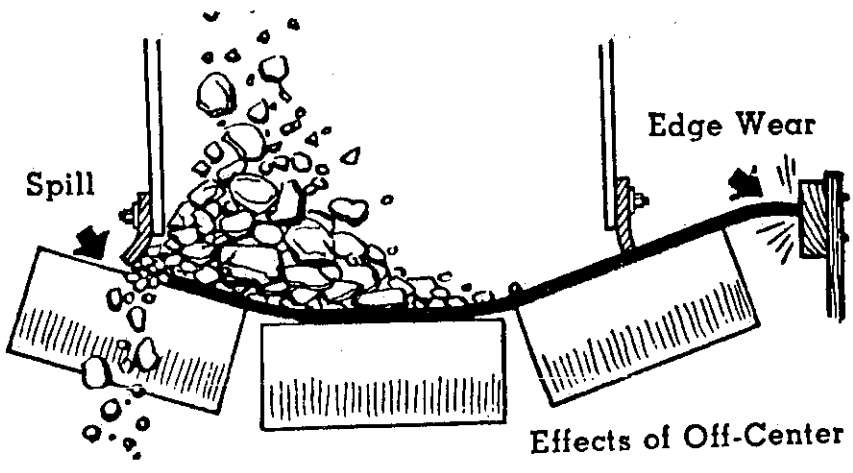
5.10 BOWED BELTS

Some new belts may tend to run off to one side, in a certain portion or portions of their length, because of temporary lateral mal-distributions of tension. Operation of the belt under tension corrects this condition in practically all cases. Use of self-aligning idlers will aid in making the correction.

A new belt invariably does not train well immediately. However, loading to 60% capacity will help the belt to settle in. Running for a while is recommended to give the belt a chance to settle in, like a car running-in period.

The subject of training a belt is only theoretical to a degree and when obvious remedial steps have been taken, the introduction of standard but specialised equipment may or may not cure the complaint and provide satisfaction. In this regard experience is a great teacher. It is our belief that the lessons of the past may be drawn on to advantage and those who have had the practical responsibility are, generally speaking, perfectly capable of teaching an errant belt good manners. The fact is that off course belting is the exception and not the rule.

5.11 OFF-CENTRE LOADING

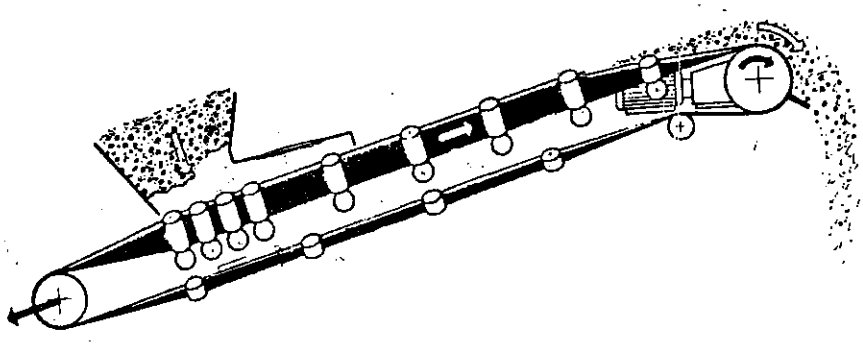


Effects of Off-Center Loading

If the belt does not receive its load uniformly centred, then the centre of gravity of the load will seek the lowest point of the troughing idlers, thus leading the belt off on its lightly loaded edge. This can be corrected by proper loading chute arrangement provided, of course, that the belt is centred as it enters the loading point.

5.12 BASIC BELT TRAINING TROUBLE SHOOTING

When all portions of a belt run off through a part of the conveyor length the cause is probably in the alignment or leveling of the conveyor structures, idlers or pulleys in that area.



If one or more portions of the belt run off at all points along the conveyor the cause is more likely in the belt itself, in the splices or in the loading of the belt.

These are the basic rules for diagnosis of belt running ills. Combinations of these things sometimes produce cases that do not appear clear-cut as to cause but if a sufficient number of belt revolutions is observed the running pattern will become clear and the cause disclosed. The usual cases when a pattern does not emerge are those of erratic running which may be found on an unloaded belt that does not trough well or a loaded belt which is not receiving its load uniformly centered.

5.13 SEQUENCE OF TRAINING OPERATIONS

Initial installation of conveyor equipment should ensure good alignment of all pulleys, troughing and return idlers,

i.e., they should be placed at right angles to the direction of belt travel, leveled and centered on a straight line. First movement of the belt should be slow and intermittent so that any tendency of the belt to run off may be quickly observed and the belt stopped before damage occurs.

When the conveyor is a long centre installation, men should be stationed at frequent intervals to observe the action of the belt. They should be provided with an effective method of communication so as to report their observations and, if necessary, cause the belt to be stopped.

Initial movement of the belt will provide indication of where corrections of the types described are required. The first corrections must be those at points where the belt is in danger of being damaged. Once the belt is clear of all danger points, a sequence of training operations can be followed.

The best procedure to use in starting the training sequence is probably to start with the return run and work toward the tail pulley. This assures early centering of the belt on the tail pulley so that it can be centrally loaded.

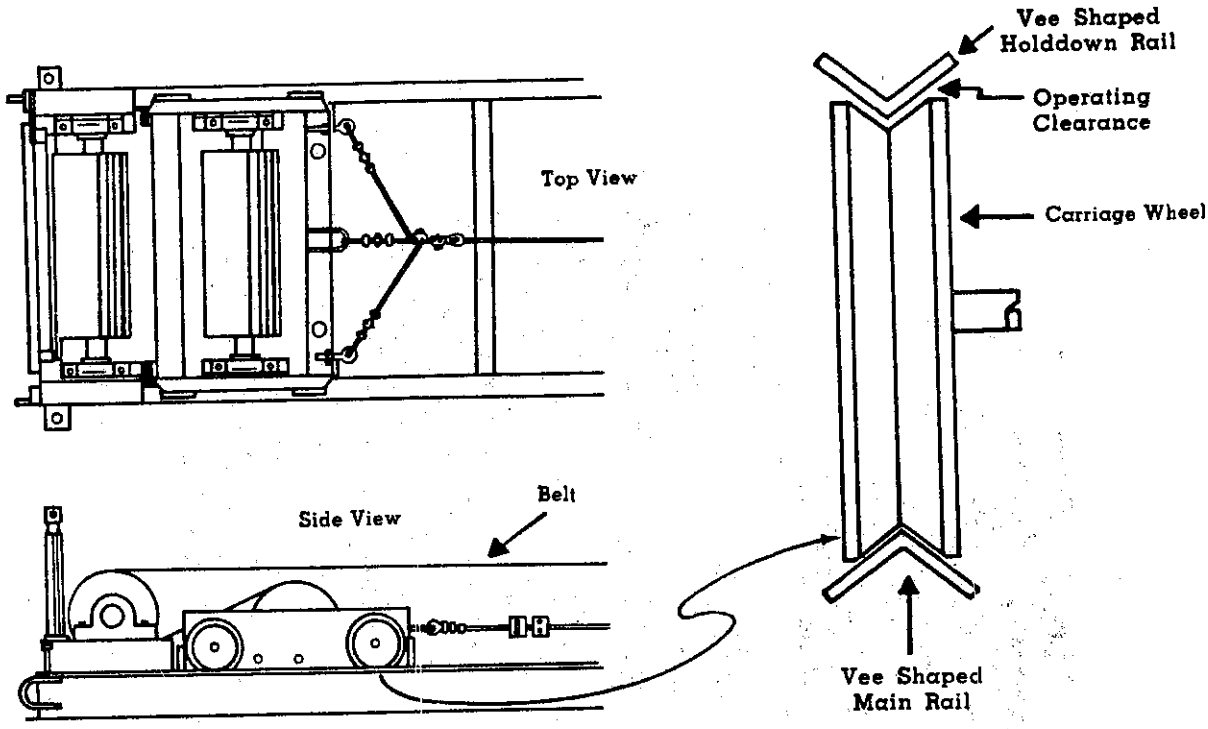
If the empty belt troughs readily, so that its running tendencies are not erratic, the training can and should be completed. Should the belt tend toward stiffness and erratic running, getting some load onto the belt as soon as the return run has been straightened up and the belt centered on the tail pulley will help hold the top run.

Normally, the belt can be trained properly onto the tail pulley by manipulation of return idlers and with the assistance of self-aligning return rolls. Seldom is any adjustment of snub pulley necessary but the snub can be used as a supplementary training means.

Training of the top run, with the belt empty, is usually no problem if the belt troughs readily. In this case self-aligners on top are not required except as insurance against damage in the region approaching the head pulley. There, two self-aligners, placed approximately 10 and 20 metres preceding the pulley, will help re-centre the belt if it is ever forced off, due to some temporary disturbance.

5.14 TAKE-UP INFLUENCE ON BELT TRAINING

The take-up carriage has a strong influence on the running of the belt at that point and, due to its movement as belt length changes, is subject to mis-alignment. A vertical take-up carriage, hanging in a festoon of belt,must be guided in its travel so that the pulley shaft remains horizontal. The belt cannot be depended upon to centre itself on the pulley and, once it moves off centre, the pulley will tip out of horizontal if not guided closely on its posts.



Sample Horizontal Take-Up Carriage

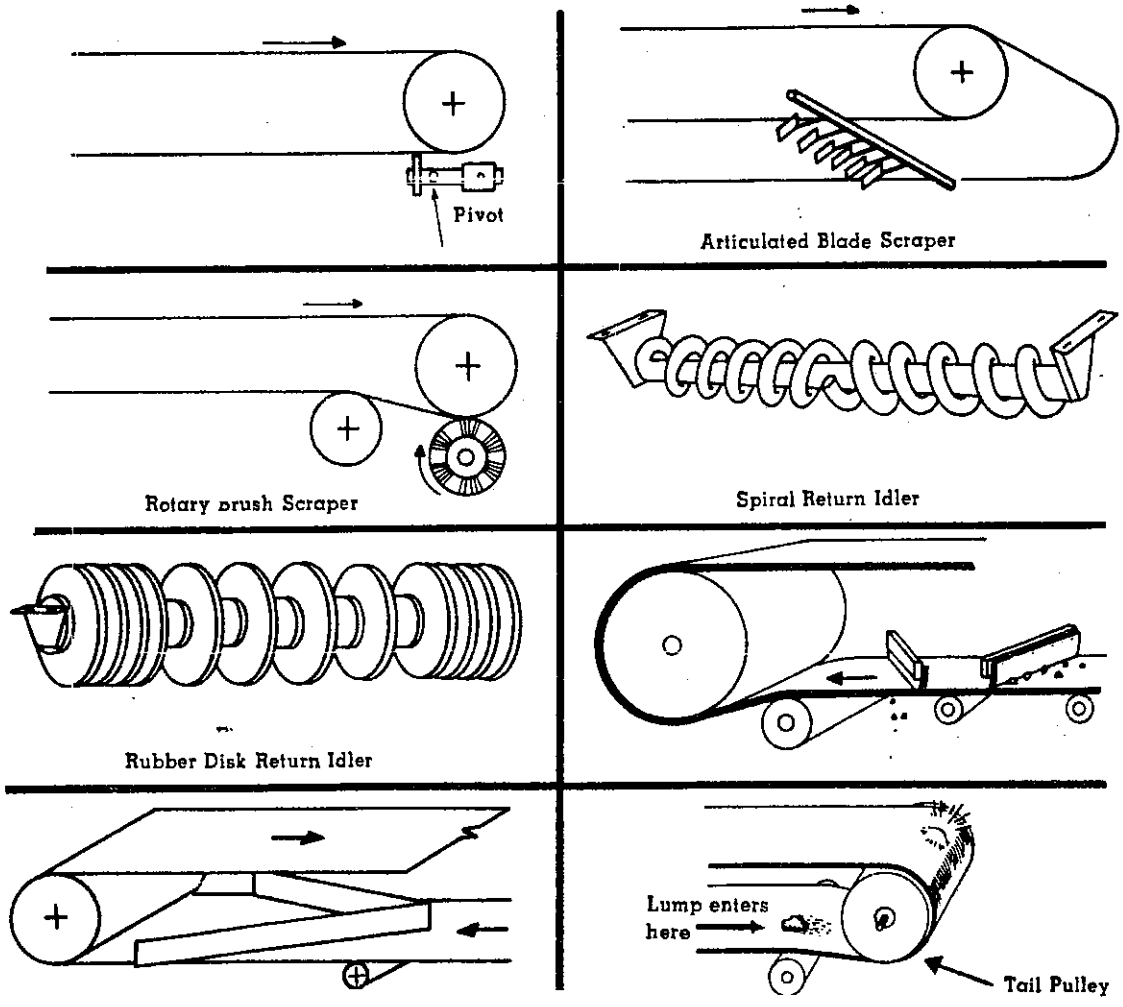
A horizontal carriage is subject to mis-alignment due to loose track gauge, fouled rails or even jumping off the track. V-shaped rails will hold the gauge tight and, with the apex upward, are self-cleaning. Hold-down rails above the wheels with sufficient clearance so that they do not touch under normal operation will help prevent jumping off the track.

A Limit switch to open the drive control circuit should be provided near the end of the take-up travel to prevent operation without adequate take-up tension and to stop the conveyor in case of belt failure. Decking should be provided to prevent material falling between belt and take-up pulley, and guards should be installed to prevent maintenance personnel from being in the way of take-up travel in either direction.

Where take-up travel is minimal, or where two take-ups are used, there is a likelihood or a probability of the take-up carriage hitting its inner travel limit. Suitable rubber bumpers should be installed to prevent damage to either hardware or belt.

6. CLEANING DEVICES

Cleaning material from the belt surface before it enters the return run of the conveyor is important. Failure to get the belt clean allows material to transfer from the belt surface to idler rolls and snubs and to fall under the conveyor. Material build-up on the rolls and snubs nullifies the training job when the rolls were clean.



Where water is available and where waste disposal or freezing is not a problem, washing the belt with a water spray followed by wiping with a rubber scraper will do a good cleaning job on almost any material. Washing and wiping has proven effective on sticky iron ores and on mixed concrete. On a 750mm wide belt, a group of seven nozzles with a 2,5mm orifice did an excellent cleaning job using about 0,05m^3 of water per minute at about 200 kPs pressure.

6.1 CLEANING PULLEY SIDE OF BELT

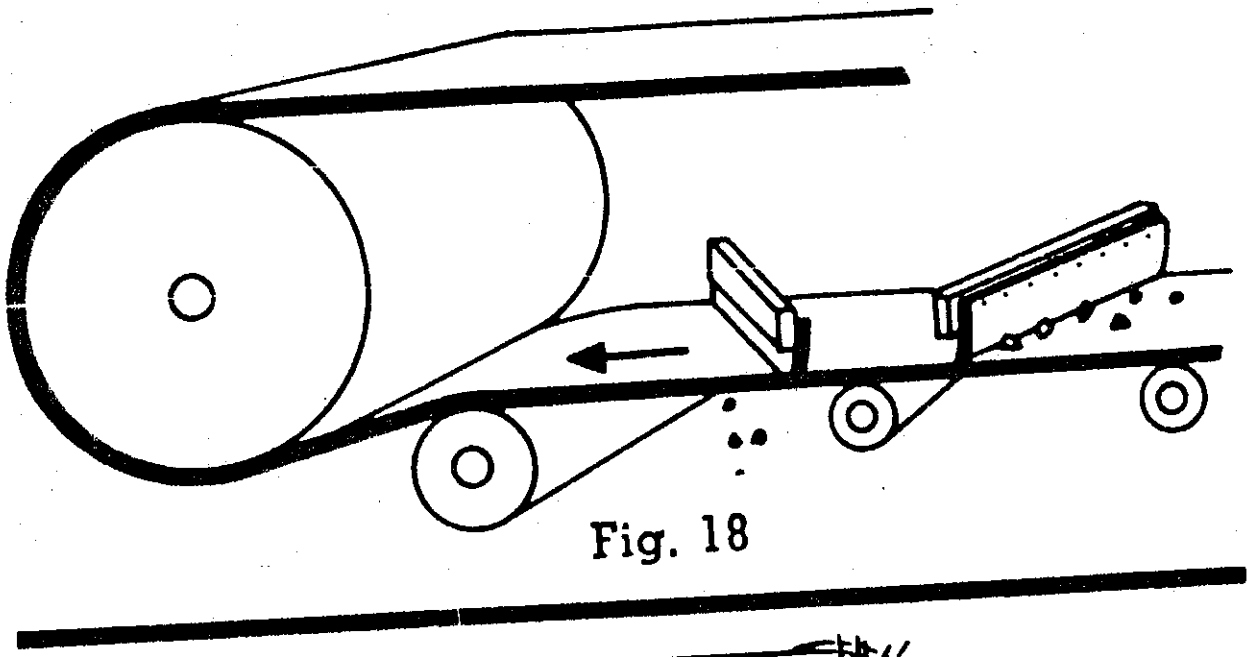
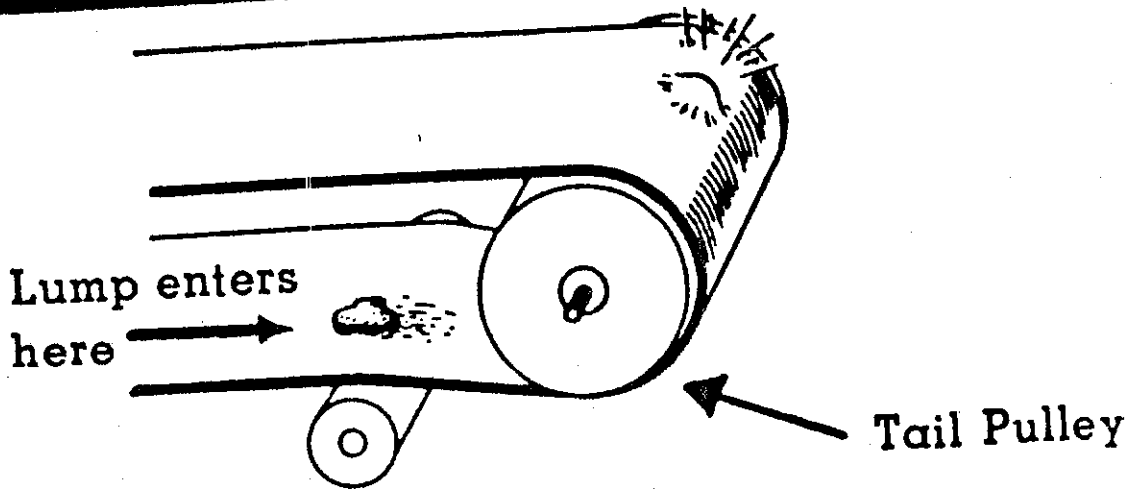
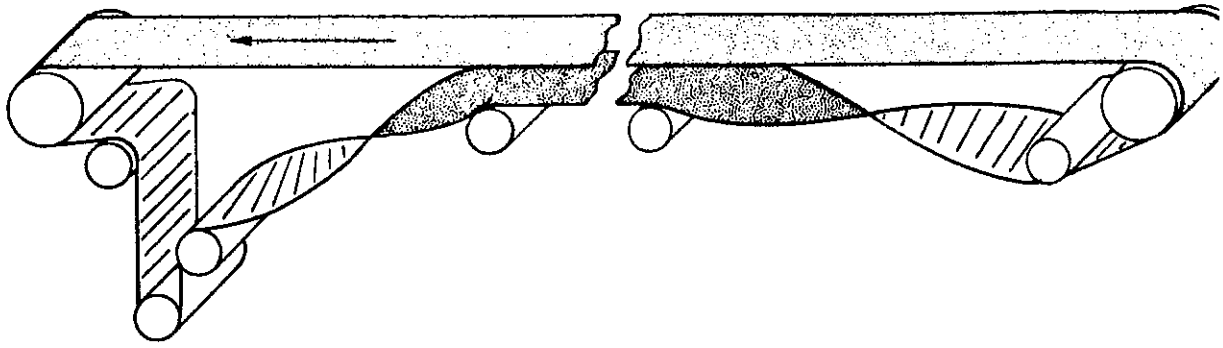


Fig. 18



The only cleaning required on the pulley side is to remove material, principally lumps, that may fall or bounce onto the return run and be carried around the tail if it is not removed. Rubber-faced plows immediately in front of the tail pulley are used for this purpose. Such plows are held against the belt by gravity. They should be suspended from points above and in front of the attachment to the plow so that the impact of lumps against the plow does not drive it downward against the belt.

6.2 TWISTED BELT



Another method avoids the need of cleaning the belt rather than providing a means of doing the cleaning. This method involves twisting the belt 180 deg after the belt passes the discharge pulley. Thus, the pulley or clean surface of the belt is in contact with the return idlers. A similar twist must be made at the opposite end of the conveyor to bring the conveying cover up again at the tail pulley.

While this method is finding more and more use, it is recommended from a belt standpoint that twisting be limited to those cases where sticky material cannot be adequately cleaned by more conventional methods. The twist increases tensions at the belt edges and reduces centre tension. This mal-distribution of tension can lead to belt buckling and even longitudinal fold-overs if the twist length is inadequate and/or other features of the twist and its installation are not proper. The belt itself may have a natural tendency to cup slightly due to cover shrinkage or, even if flat when new, it may tend to cup later for a variety of reasons, which can lead to twist problems.

Consult Goodyear for twist length recommendations.

6.3 IDLER SLEEVES/LAGGING

Soft lagging on idlers or "Sta Kleen" self cleaning idler sleeves may be the answer for your particular problem of keeping material from accumulating on idlers, but experimenting is advisable.

7. LOADING

The subject of chute design falls outside the scope of this paper. In lieu of such a discussion, the following are offered.

The loading point of any conveyor is nearly always the critical point, the life determining point of the belt. Here the conveyor receives its major abrasion, and practically all of its impact. This indicates a necessity for regular inspections in this area. The "ideal condition" is to have the material pass from chute to belt at the same speed and direction of travel as the belt with a minimum amount of impact, and the material placed centrally and uniformly on the belt. This goes a long way towards longer belt life. Less wear on covers and less chance of carcass damage.

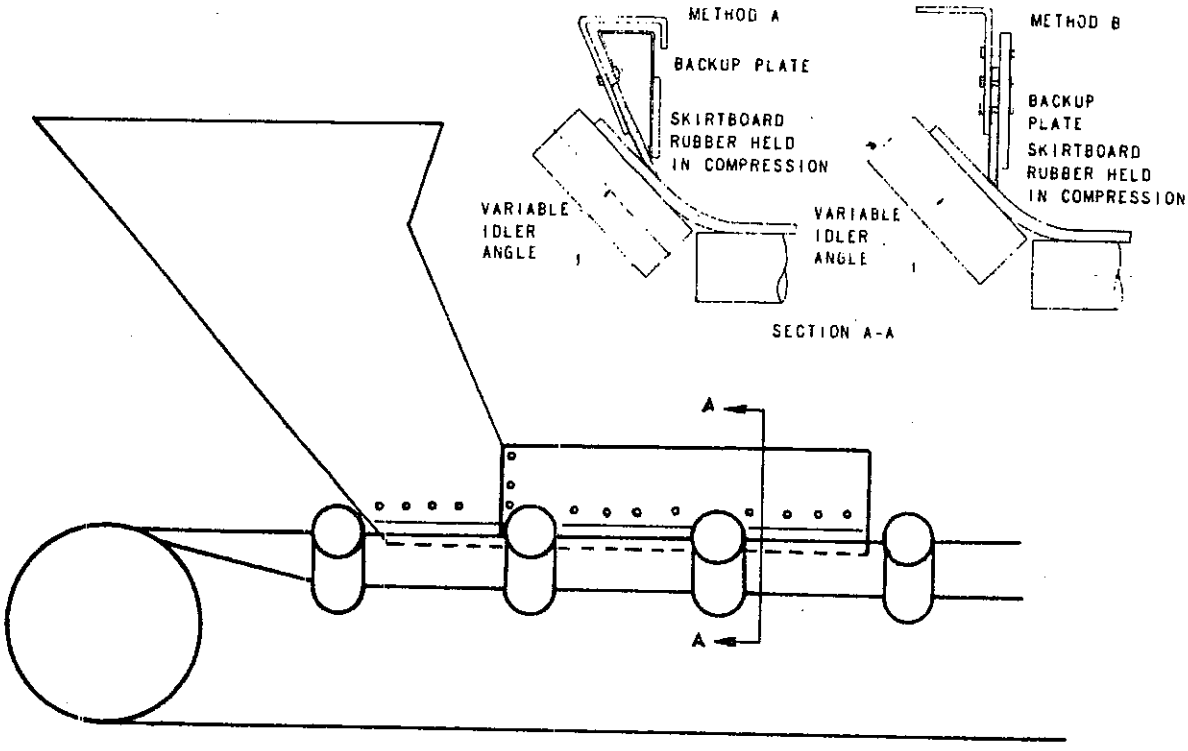
There is no doubt that one can get a chute efficient enough to put all the material on the belt, but will it be efficient enough to prevent costly belt wear?

Short transition belts to take the major impact and wear are recommended to guide the load onto long, important conveyors in the same direction and speed as the main conveyors.

Loading on an incline can increase cover wear rate sharply compared to level loading. This is because of load turbulence and slippage as the load settles on the belt and reaches belt speeds. In one particular case where records were kept, a belt loaded on a 14 degree slope had top cover wear roughly three times greater than the belt onto which it emptied with level loading.

Some shifting of the load takes place as it rides over each idler, and in the case of large lumps of material, the belt carcass is subjectedto a lot of impact as it receives a

8. SKIRT BOARDS

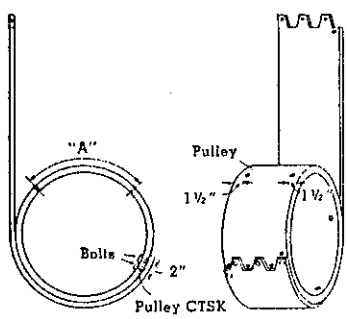


Common Skirt Board Arrangements

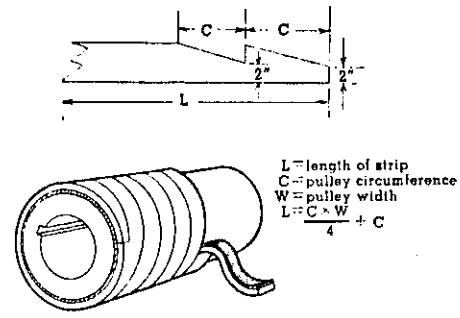
The chute, having delivered its load to the succeeding belt, has no further control of the material. Since no chute does its job perfectly, the load has not taken the exact direction, speed, or shape required on the receiving belt. Hence, there will be some turbulence of the load and rolling on the belt. To prevent material falling from the belt or loading too close to its edges, skirt boards are used to confine it for a few seconds until it settles.

Our experience has been that using dual skirting similar to a labyrinth seal is the best way to handle the job. The inner skirtboard to form the load and deflect it away from the out, skirting which prevents the fines from seeping through.

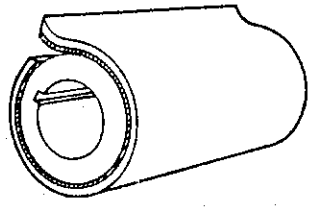
9. PULLEY LAGGING



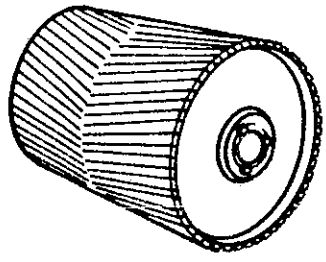
Dovetailed Ends of Bolted Pulley Lagging.



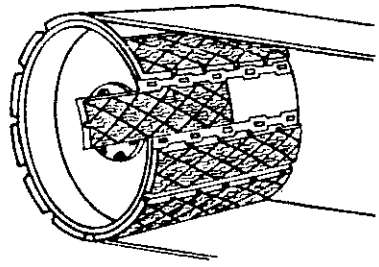
Spiral Wrap Method of Applying Vulcanized Lagging.



Sheet Wrap Method of Applying Vulcanized Lagging.



Typical Herringbone Grooved Pulley Lagging.



Slide-Lag™ Replaceable Pad Pulley Lagging

Slide-Lag™ — Trademark and Patent by Holz Rubber Company, Lodi, California.

Lagging is recommended for drive pulleys for the following reasons :

9.1 Improved co-efficient of friction. This permits a belt to be driven by lower slack side tension and sometimes results in lower total tension.

9.2 Reduction of slippage due to wet conditions if grooved lagging is used. (Wet PVC belting increases co-efficient of friction and in such cases bare pulleys are common).

9.3 Increased life for pulley and bottom cover of belt.

9.4 Other pulleys in the system, especially those contacting carrying side of the belt, are often lagged to prevent build-up of material. Grooving improves cleaning action on the lagging and the belt.

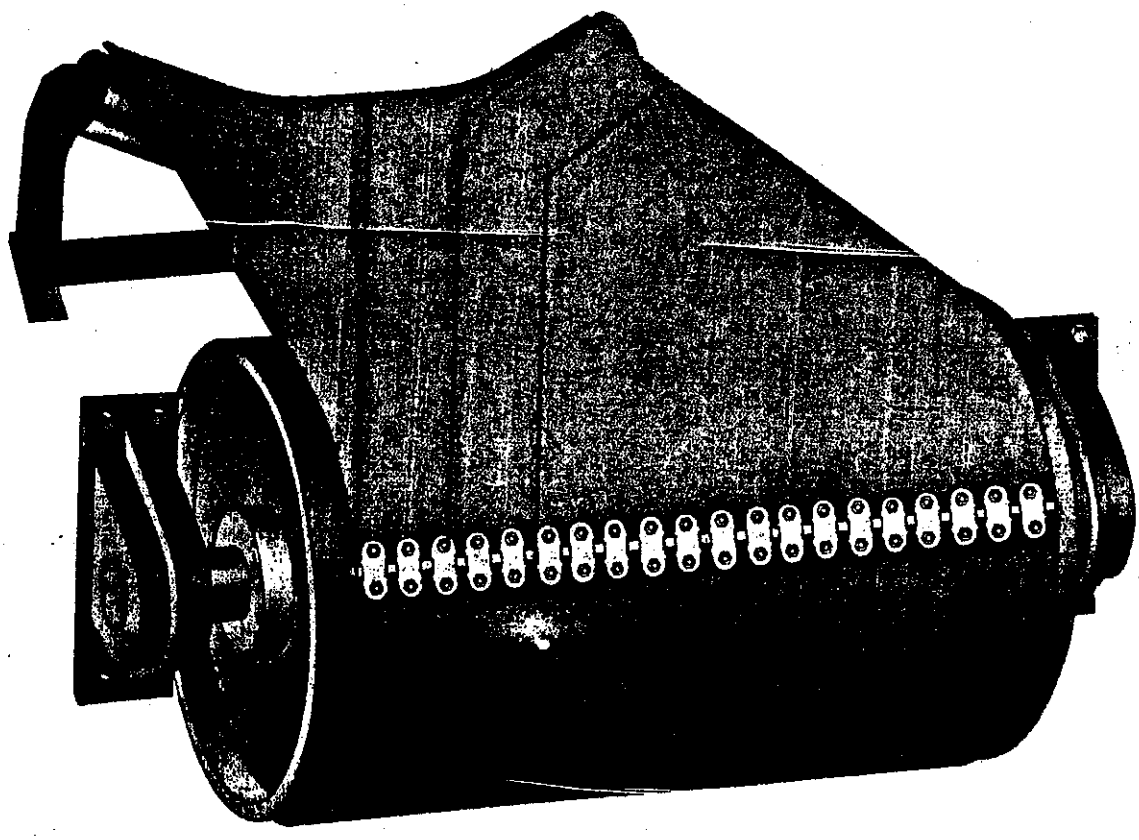
Incidental but valuable uses are tapered laggings to reduce or erase crown and diameter correcting laggings to adjust two-pulley drives to the pitch diameters required for proper load distribution.

Tests on a dynamometer showed that, with a properly grooved lagging, water could be squeezed out and a driving capacity equal to that of dry belt on smooth lagging could be obtained.

Where there is no problem of wet drives, grooved lagging is sometimes justified by its increased deflection under belt pressure, which helps to break dirt accumulations.

10. PULLEY DIAMETERS

Few present day belts fail due to ply separation, which theortically should occur from running belts over pulleys that are too small. But there are plenty of belts that are giving short splice life, particularly when metal lacings are used.



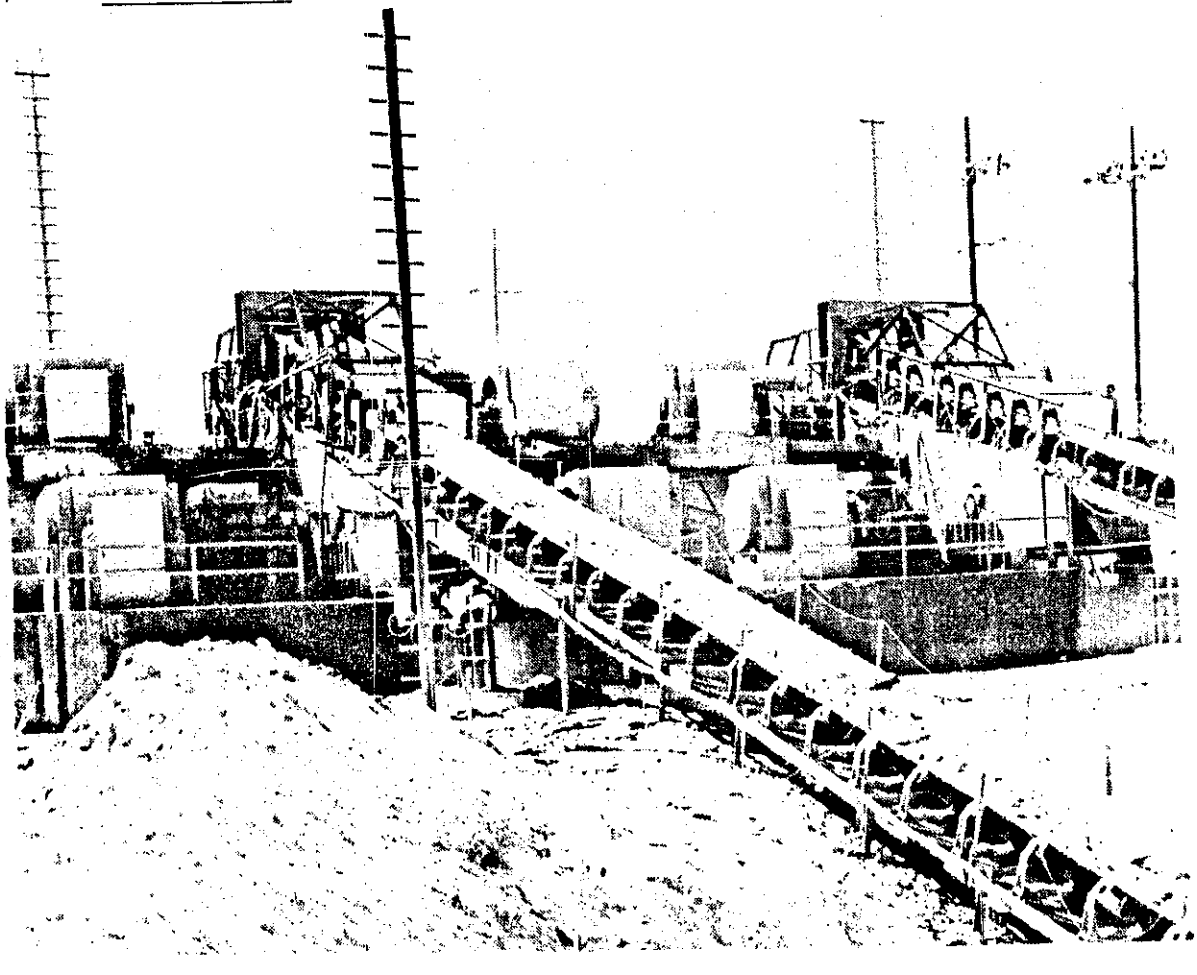
A belt has to distort in going around a pulley. The outer plies are stretched and the inner plies are under compression. The amount of distortion depends on the thickness of the belt, and the arc through which it is bent. This stretching of the outer plies can be distributed over a long or short distance depending on the diameter of the pulley over which it is being flexed.

For minimum recommended pulley diameters, consult the conveyor belt manufacturer.

10.1 FACE WIDTH OF PULLEYS

It is common practice to make the pulley face about 50mm greater than belt width for widths through 1000mm and about 75mm greater for widths more than 1000mm. However, Goodyear recommends increasing these standard values to 75 and 100mm, respectively, as a protective measure for the belt. For long, highly stresssed, costly belts and all steel cable belts, the insurance against edge damage to the belt provided by extra face width on the pulleys is well worth its cost. For such cases, the next larger standard face width should be used.

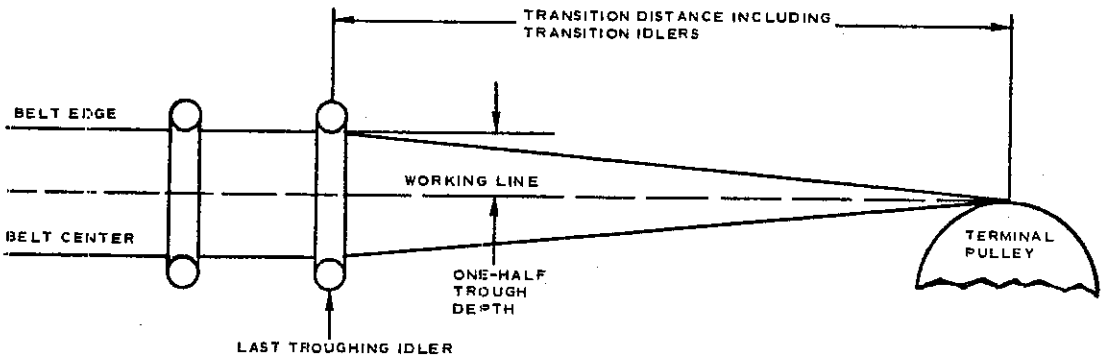
11. DRIVE MOTORS



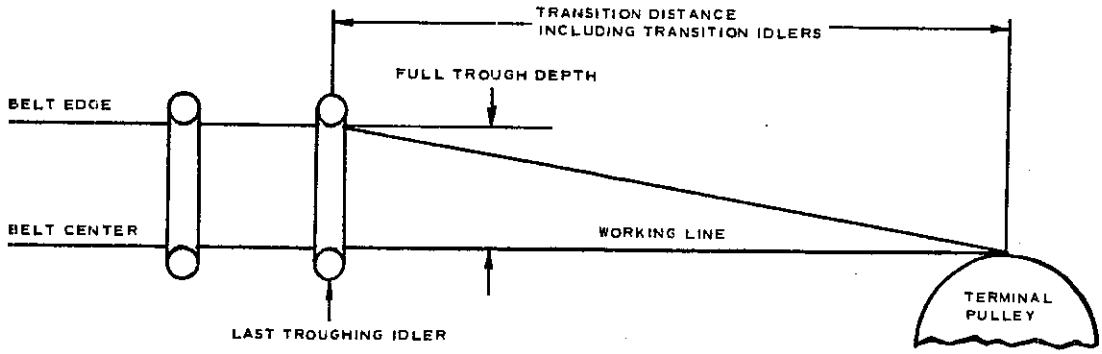
In selecting a motor or motors for a belt drive, don't put in a 200 kW motor just to be on the safe side, when your calculations indicate that a 100 kW one will do the job. Belts have to be started and stopped. But don't do it any oftener than necessary, and when they are started don't have extra power putting extra starting stress into the belting. This doesn't help the belting any.

Use some form of controlled starting wherever possible. In our autos we have a selection of gears, some sort of a clutch, and an accelerator pedal to enable us to get the cars under motion without snapping off the heads of the passengers. Across-the-line starting of a conveyor drive motor is not conducive to long belt and splice life.

12. TRANSITIONS



POSITION A – RECOMMENDED POSITION WHEREVER POSSIBLE



POSITION B

Two Commonly Used Terminal Pulley Positions

In changing the troughed belt to a flat section at the head pulley or the flat belt to a troughed section at the tail pulley, edge tensions are increased as the edges are stretched between the last idler and the pulley. This tension mal-distribution can be kept within safe limits by maintaining a proper transition distance between the last trough idler and the pulley to minimize the stretch induced into the belt edges. At the head (high tension end), the purpose is to avoid excessively high edge tensions. At the tail (low tension end), excessive edge tensions rarely will be encountered. If the transition is too short, however, an excessive difference between edge and centre tensions can overcome lateral belt stiffness, pull the belt down into the trough, and buckle it through the centre or force it into the idler junctions.

For minimum recommended transition distance, consult the conveyor belt manufacturer.

13. BELT STRETCH

The more highly a belt is stressed the more it will stretch. The extra stress causes more frequent take-up adjustments for screw-type take-ups or more travel for automatic-type take-ups.

The amount of elastic stretch that appears due to changes in load depends on the nature of the belt and on the degree of load change. Inelastic length change depends on the nature of the belt and the degree of belt stress.

Predicting the amounts of stretch with any degree of accuracy becomes difficult because of the many variables involved. A belt that would stretch 1 percent at one installation might stretch 1-1/2 percent at another. The following are some of the factors that can affect the amount of belt stretch in addition to the type of fibre, twist, crimp, and general belt fabric design.

13.1. Installation - The tighter a belt is installed, the less stretch will be realised later.

13.2. Drive location - Should a drive be located at the low tension end, the average belt tension will be substantially

increased while maximum tension will increase little if at all. Total belt stretch will be increased because it is a function of average tension.

13.3. Moisture - Moisture content can affect belt stretch and, if high enough, can even cause shrinkage.

13.4. Loaded starts - Loaded starts impart a surge of tension to the belt above operating tensions. If such starts are frequent, it is obvious that the belt may stretch more than if started only occasionally.

13.5. Type of starts - In addition to the frequency of starts, a motor that starts across the line will usually impart a much greater tension surge to the belt than a motor that has carefully controlled start to limit torque.

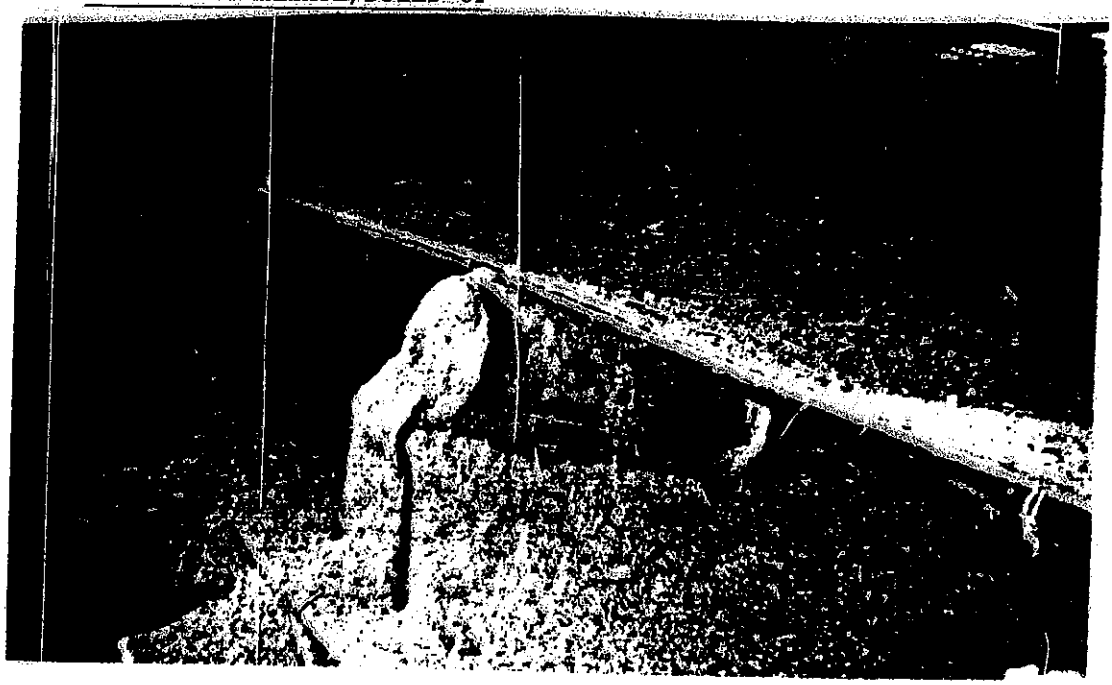
13.6. Braking - Belts that are stopped by brakes may be subject to overstresses and, as with starting, the greater the stress and frequency, the greater the stretch.

As a general rule, Nylon belts can be expected to stretch 1 to 2 percent with proper installation.

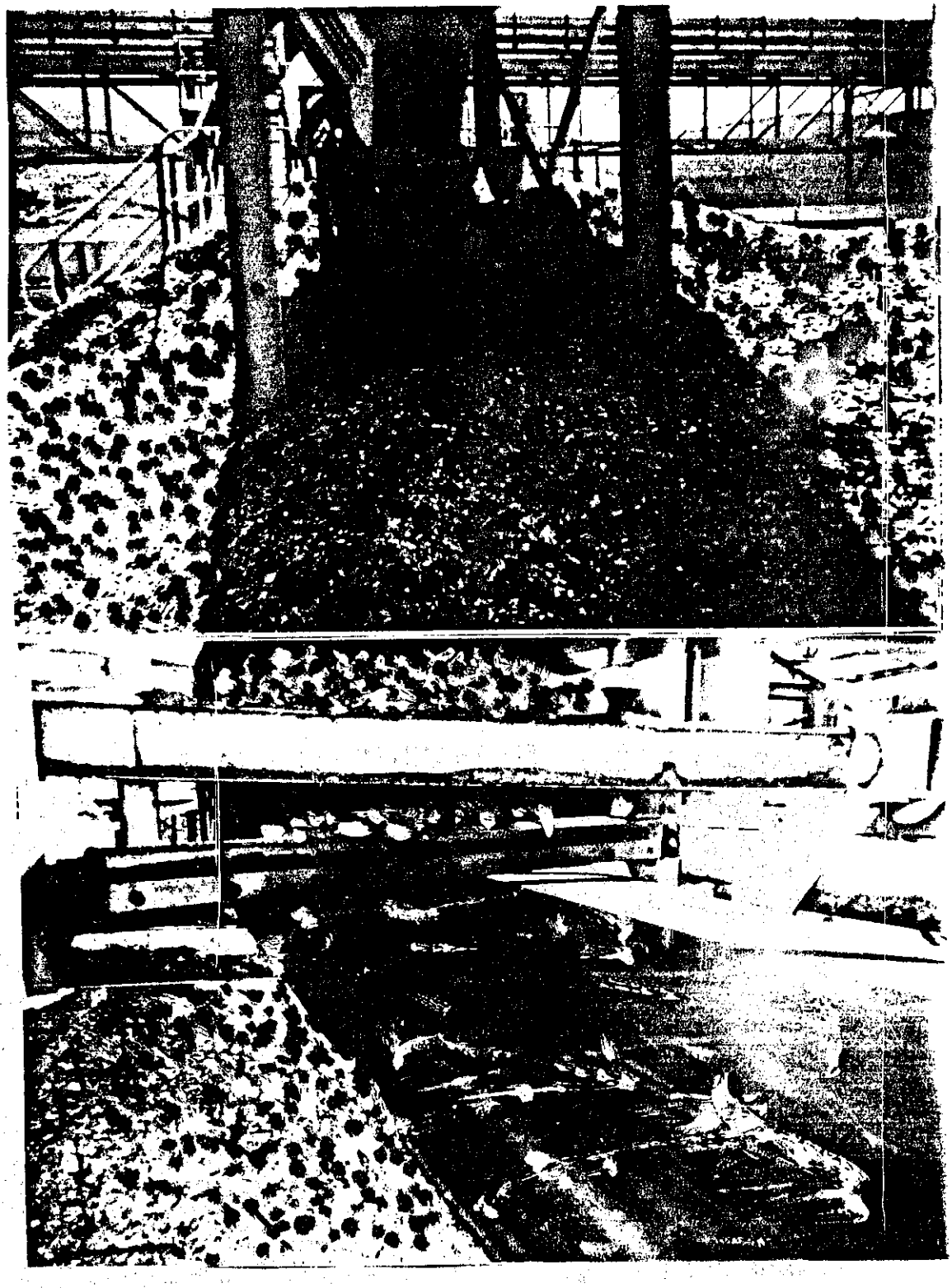
The elastic length changes in a belt due to load changes can be calculated with a degree of accuracy that hinges on the accuracy of tension calculations and elastic modulus.

14. OTHER FACTORS CAUSING CONVEYOR BELTS TO FAIL PREMATURELY

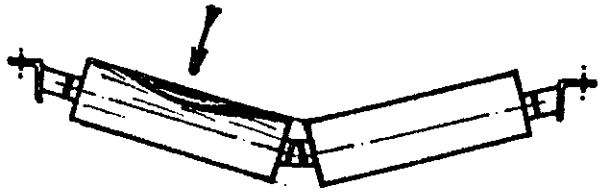
14.1 MATERIAL SPILLAGE/BUILD-UP

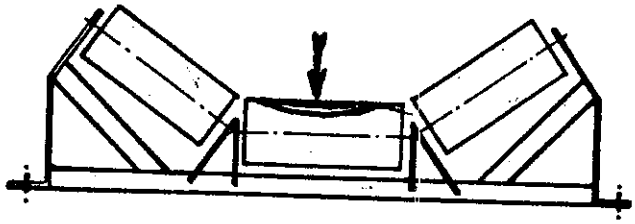


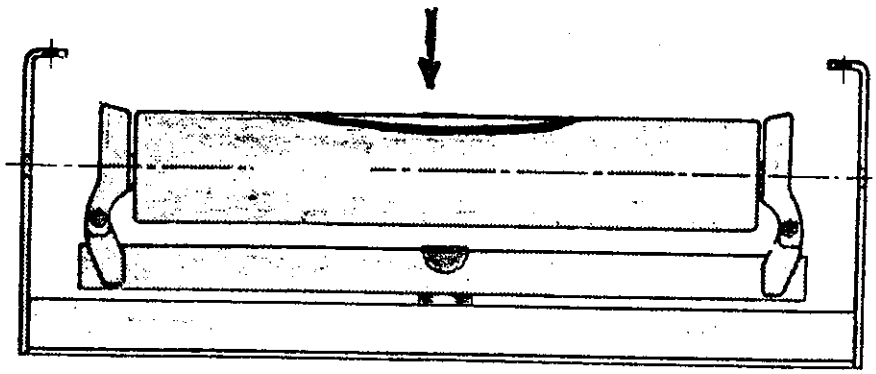
Material spillage and build-up on deck plates, on the ground underneath the belt, at the tail and terminal pulleys and on take-up counterweight boxes and elsewhere seems to be a big problem in this country. We have seen many belts worn through to the carcass in months, due to the belt being dragged through a trough of material instead of running over idlers. This of course also causes excessive wear on the idlers, overloading of the motors and excessive power consumed. Don't allow this to happen - remove accumulations and rectify cause/s.



14.2 FROZEN IDLERS



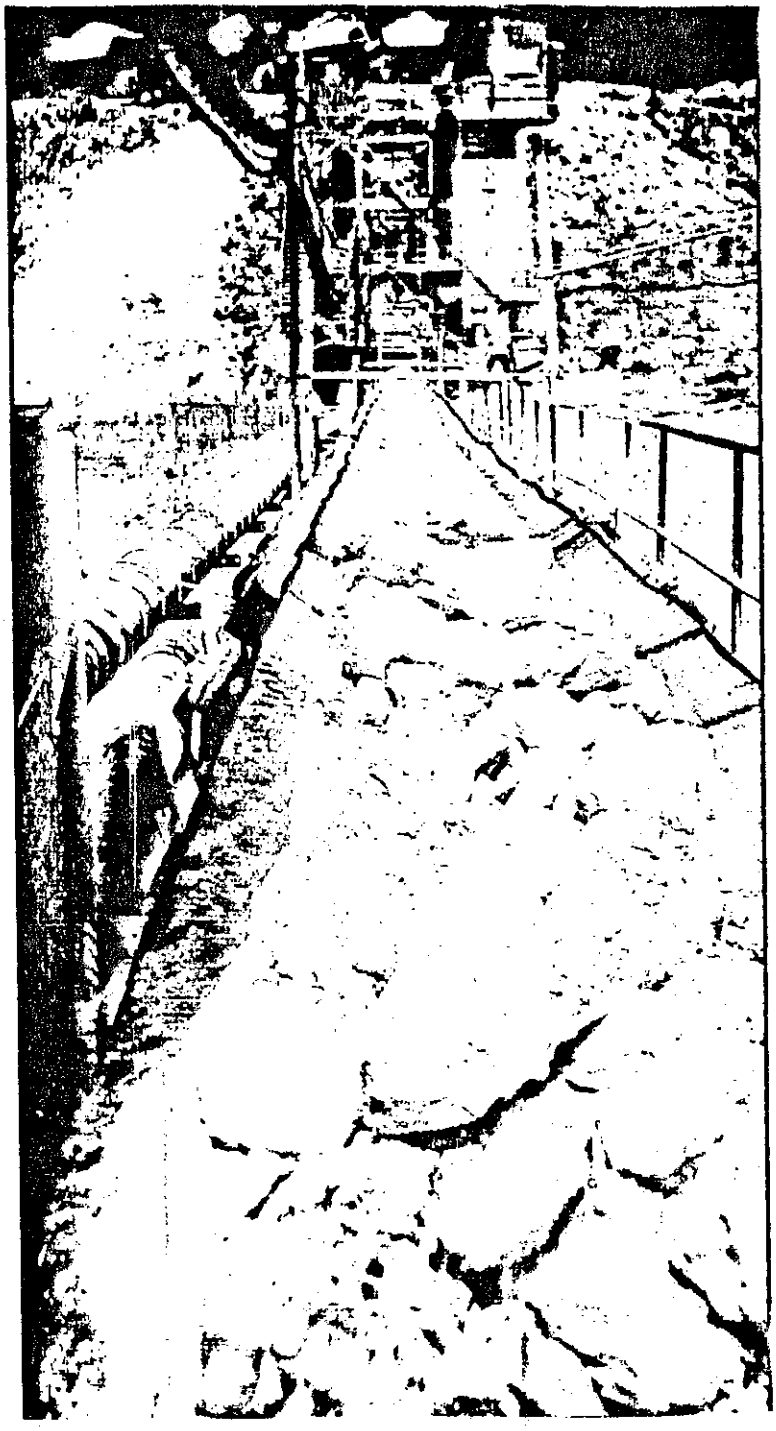




Frozen idlers could be worn to a razor sharp edge within a short span of time, resulting in belt cover being peeled off.

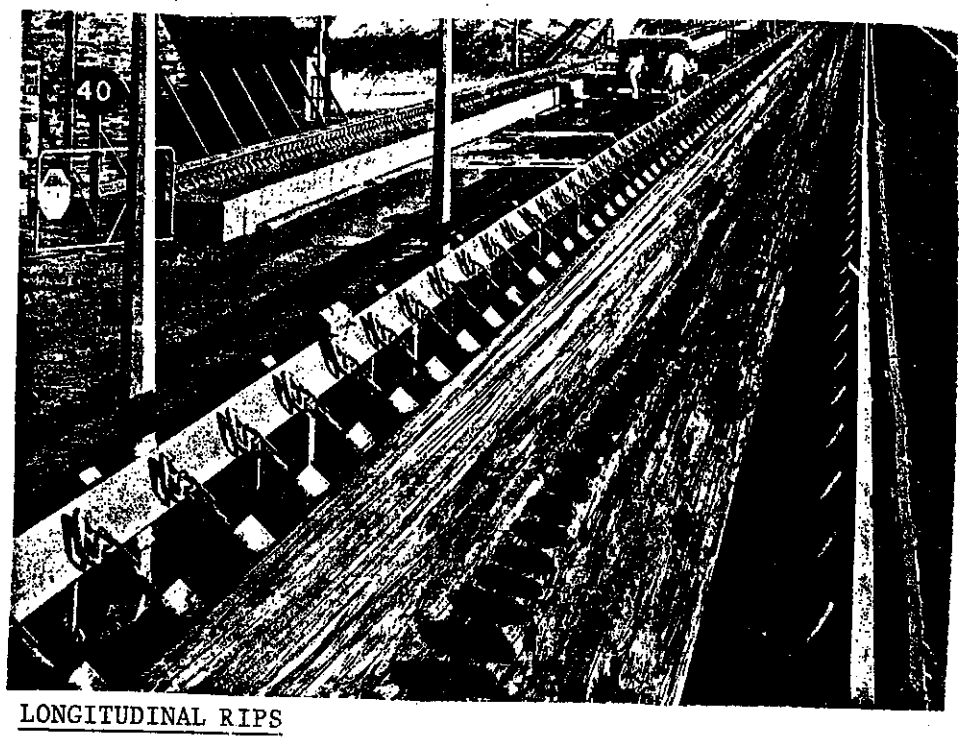
Frozen idlers also cause excessive power consumed due to increased friction.

15. BELT SAG



Excessive sag between carrying idlers causing load to work and shuffle on belt as it passes over idlers. This results in excessive top cover wear. They could increase the tension if unnecessarily low or reduce the idler spacing.

Idler spacing and belt tension must be kept in proper relation, and adequate transverse stability of carcass must be provided to try to hold this load-shifting wear to as low a value as possible.



16. LONGITUDINAL RIPS

Could be caused by :

Jamming of material in the chute,

Penetration of foreign material (such as steel rod), idler bracket with idler missing.

Belt folding over on itself and going around pulleys or idler junction failure.

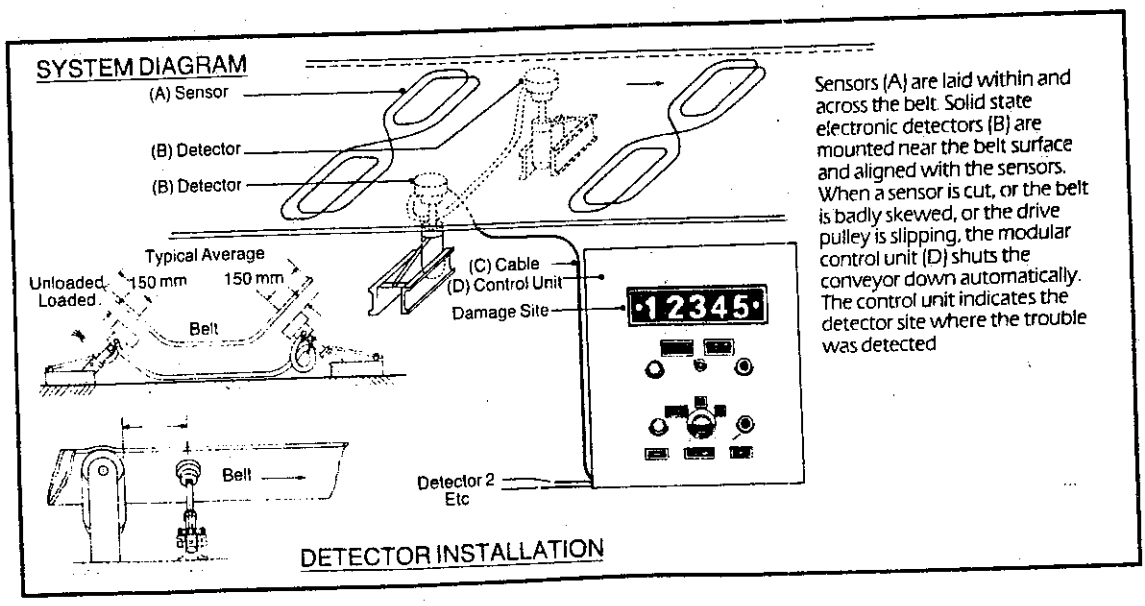
With all the safety devices such as pull cords, belt limit switches, chute plugging switches, drive pulley belt slip switches, magnetic detection and magnetic removal of tramp iron etc., belt conveyor operation has become quite automatic. A belt conveyor of several kilometers in length may require only two or three men for operation or maintenance.

However, there is one type of accident for which preventive equipment has long been necessary. If some type of tramp iron, loosened steel skirt, or loosened scraper penetrates through the belt and becomes wedged at a transfer or loading point, a long length of expensive belt may be slit entirely. This is because the wedged material can follow and be guided along between two cords in a steel cord belt or between groups of warp (lengthwise) strands in a fabric ply belt.

Especially where long, expensive belting is used, some type of rip detection device should be used for stopping the belt if a rip gets started. Recently domestic as well as some overseas belting manufacturers have such devices and have had them installed for in field service.

Costly plant shutdowns, the result of serious belt damage on a critical conveyor, can be virtually eliminated. Specially designed sensors are embedded in the bottom cover of the belt at predetermined intervals. Small solid state detectors are located at critical points along the conveyor system. If a sensor is cut, the detector reads the open circuit, and the belt is stopped automatically. A light at the modular control unit shows which detector is "reporting" damage, so that trouble can be located quickly. In the case of excessive belt runout, movement of the sensor away from the detector has the same effect as cutting the sensor. The belt is shut down automatically so that the trouble can be located and corrected immediately. The detector is designed to receive signals from the belt sensors at pre-set time intervals. Should belt slippage occur at the drive pulley location and the detector does not receive a signal during this time period, the belt will automatically be shut down.

Once installed, it requires minimal maintenance. The Sensor Guard Protection System has excellent immunity to vibration, electrostatic leakage and electro-magnetic interference. The sensors and solid state detectors are immune to the effects of water and dirt so that the system works equally well above or below ground.



17. INSPECTIONS

In summary, a small group of well-trained and motivated maintenance personnel is necessary for the long-term success of a conveyor system. These people, combined with a strong preventive maintenance programme and a good stock of spare parts, can ensure many years of dependable opration.

I've run into only a few maintenance men that concentrated on taking care of the equipment so that they didn't have breakdowns. The rest have all prided themselves on the fact that when they had a breakdown it only took them a few minutes or hours or days to get the equipment back in operation. They can't anticipate breakdowns because of defective equipment, but if they are going to prevent breakdowns from wear and service they have to know their equipment, and they have to set up a rigid method of inspection and replacement before breakdowns occur.

You may put a man in charge of conveyors. Have him set up a system of inspections for motors, electrical controls, reducers, chutes, belting, idlers, pulleys, conveyor alignment. You may pay him on the basis of preventing torn belts, worn and gouged covers, broken splices and shutdowns. The more conveyor you have the more you have need for such a man.

A single belt may cost ten or forty thousand Rand. Why not spend some money for the equipment necessary to keep it in tip top shape?

You could keep records of your costs. Put in some recording equipment so you know how much power it takes to operate your various conveyors. If you know the kilowatt hours used on each conveyor each month and the number of tons conveyed per month, you can figure a constant of power used per 100 tons conveyed 100 metres without lift, or some other constant that will fit your particular needs. You may use this constant as a check on the quality of your equipment. When the constant goes up, it means that something needs attention on the conveyor.

You could keep track of what it costs them to keep their belting repaired. You should be able to develop tonnage for each conveyor. When it figures out to be cheaper to put in a new belt than to try and keep the old one in proper repair, you should not wait for the old one to go to pieces - it should be replaced. Conveyors have been used, are being used, and will continue to be used in increasing numbers because they handle material easily in small or large quantities, continuously or intermittently and in most cases more cheaply than any other method.

I realise that it is not possible in all instances to do everything recommended today, especially as far as the regular inspections are concerned - shortage of labour, budgets to stick to, too many conveyors etc. but maybe the people responsible for setting the budgets should be a little more lenient as far as conveyor maintenance goes.

For instance, a couple of frozen idlers needs replacement immediately. Say it would cost R1000. Your budget does not allow for a further R1000. What they don't realise is that if those idlers are not replaced, it may destroy a belt worth R500 per metre. Surely that must be false economy.

The recommendations made in this paper don't have to be followed to make a conveyor work, but they will help the user to get more from them.