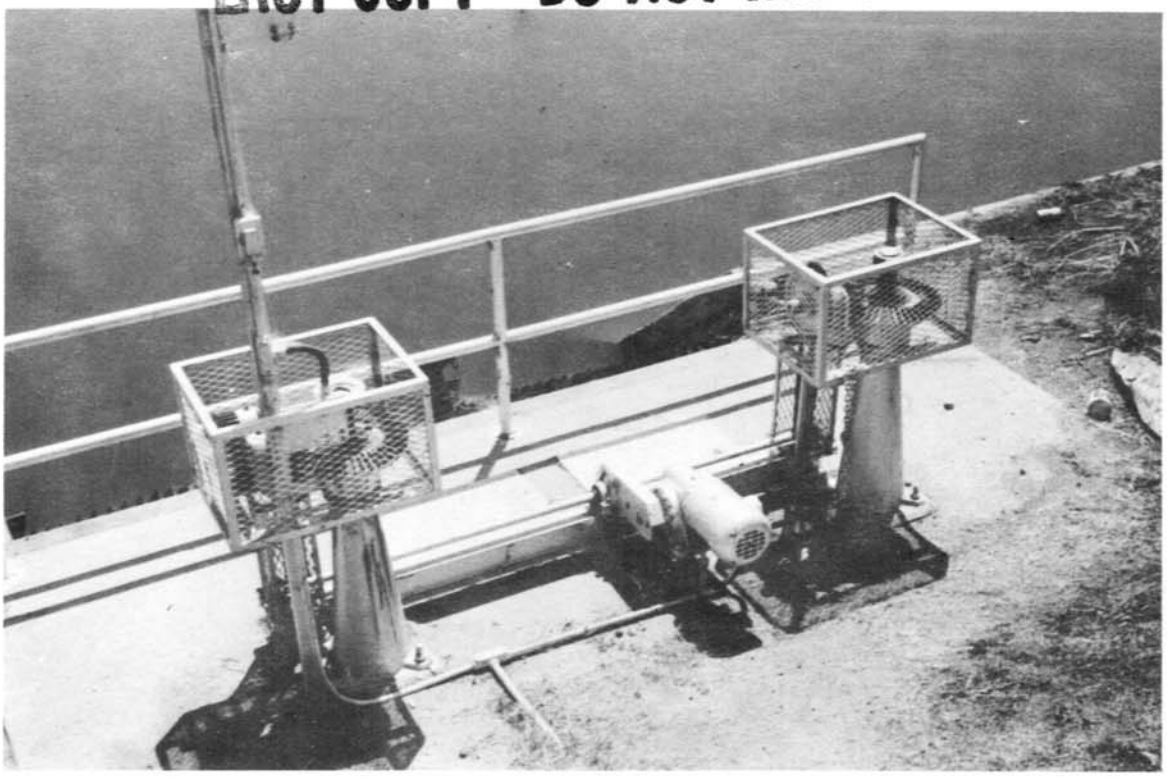
Department of the Interior

Bureau of Reclamation

OPERATION AND MAINTENANCE EQUIPMENT AND PROCEDURES

RELEASE NO. 26

October, November and December 1958



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INTRODUCTION

"It's all too easy to neglect some simple maintenance task. It happens all the time . . . . . " Construction Methods and Equipment, published by the McGraw-Hill Publishing Co., 330 West 42nd St., New York 36, N. Y., enlisted the help of a group of experts to point out specifically where mistakes in equipment maintenance are most costly. Aimed at the construction industry, many of the pointers will be of interest to O&M organizations on the many irrigation projects using similar equipment. We have obtained the permission of the publisher to reprint the advice. The first of the articles begins on page 7.

This bulletin, published quarterly, is circulated for the benefit of irrigation project operation and maintenance people. Its principal purpose is to serve as a medium of exchanging operation and maintenance information. Reference to a trade name does not constitute the endorsement of a particular product, and omission of any commercially available item does not imply discrimination against any manufacturer. It is hoped that the labor-saving devices or less costly equipment developed by the resourceful water users will be a step toward commercial development of equipment for use on irrigation projects in a continued effort to reduce costs and increase operating efficiency.

In order to insure proper recognition to those individuals whose suggestions are published in this and subsequent bulletins, the suggestion number as well as the person's name is being given. All Bureau offices are reminded to notify their Suggestions Awards Committee when a suggestion is adopted.

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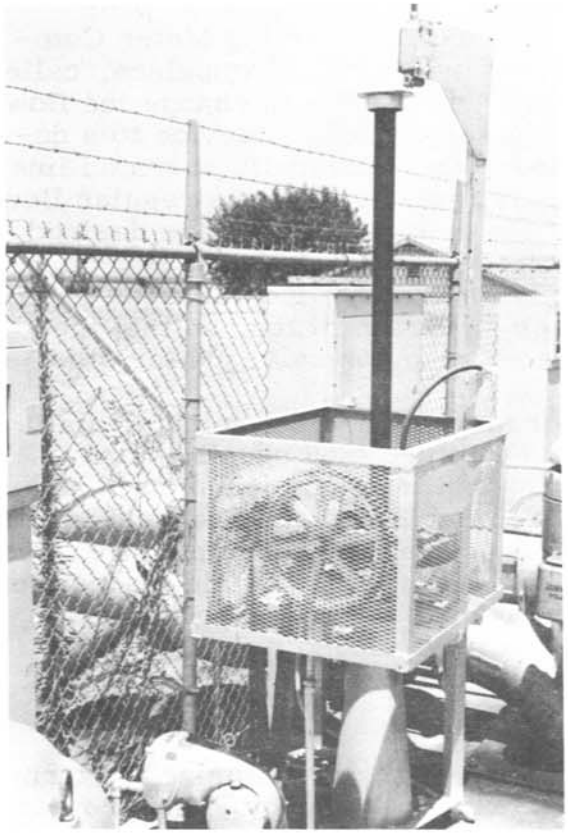
Division of Irrigation Operations
Commissioner's Office
Denver, Colorado

AUTOMATIC DEVICE SIMPLIFIES WATER DELIVERIES TO GRAVITY PIPELINE SYSTEMS

During the initial years of operation of the pipeline distribution system of the Southern San Joaquin Municipal Utility District, Central Valley Project, considerable difficulty was encountered in delivering the exact water requirements from the main Friant-Kern Canal to several of the District's gravity pipeline systems.



One of the gravity lines, called Pond Avenue West, at Mile 124.5, gave so much trouble due to surging and reaction to small changes in canal elevation, it was decided to try to develop an automatic device to control deliveries to this pipeline. The first installation was so successful that two other installations have now been made.

The development, construction and operation of the device is described in this article prepared by G. D. Nielsen, Head, Water Operations Section, Fresno Operations Field Branch, Central Valley Project, Region 2, Bureau of Reclamation.

The photograph at left is of the first experimental installation made at a single barrel turnout. The gear motor and sprocket chain required to operate a single stem at the head of a lateral is shown. The mechanism at the top of the stem gate is a limit switch to prevent the gate from being opened too far.

The photograph on the cover of this issue of the bulletin is of an installation made on a two-barrel turnout in which the control gates are immediately adjacent to the canal. Both gates may be operated simultaneously by this automatic mechanism, or one gate can be operated independently by removal of the bicycle chain from one of the stem gates.

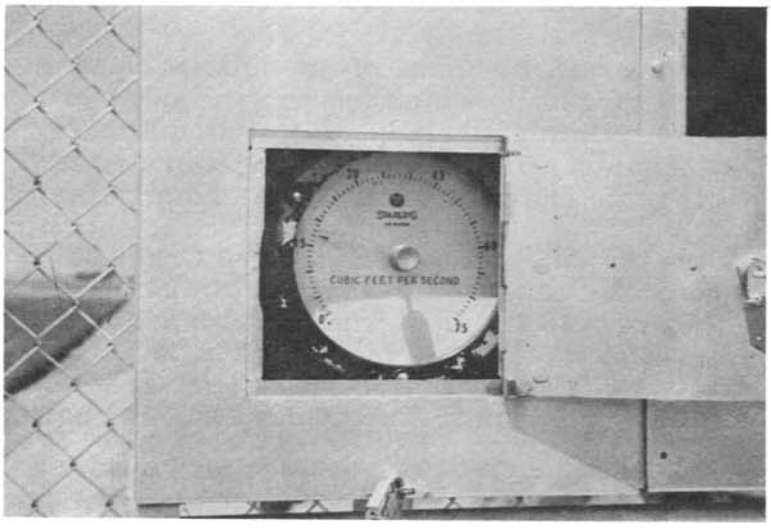
The District's lands are divided by the Friant-Kern Canal so that the higher lands to the east of the canal are served by a high pressure pumping system, while the lands to the west which are predominantly and generally sloping downward at about 25 to 30 feet to the mile, are served by a low pressure gravity system. It is this latter system which created the most serious operating problems. The vent stands and junction

boxes will overflow and cause damage if a small surplus of water is turned into the line, or the necessary delivery-head will be lost if there is a shortage of water in the line. Some of these lines are also particularly subject to surge and are sensitive to a change of head in the canal. It is therefore very difficult to maintain exactly the desired amount of flow in each line, even though the Friant-Kern Canal is operated within fairly close limits of fluctuation.

The District has six large gravity lines running west from the canal. Each of these lines is provided with a Sparling "Type S" propeller meter. It was found through inquiry that the Sparling Meter Company manufacturers a device which operates by electrical impulses, called a "Flow Rate Selector." With this device it is possible to change the flow in a pipe line by merely setting the hand on the dial of the device to a desired flow. The device then opens or closes an electrically operated line valve (or gate) until the flow in the pipe, as registered on the regular flow meter, coincides with the dial setting of the selector. After the desired rate of flow is reached the device holds the rate steady against source head changes by small automatic manipulations of the line valve (or gate). The flow rate selector includes a totalizer and transmitter, so that the original totalizer may be turned in to the company or salvaged for other use.

There are two types of "selectors." One has the selector dial and control attached to the meter head. The other (and usually more practical) is remote or panel controlled so that it can be mounted in an electrical control panel or any other convenient location. The first installation on Pond Avenue West lateral, shown on the preceding page, was of the first type and this device worked so well that the District asked the Bureau to help them install two more at the Bassett and Airport laterals (Miles 119.6 and 122.5). These two were of the second type, panel-mounted, (photograph on cover page) which work equally well and are much handier to operate.

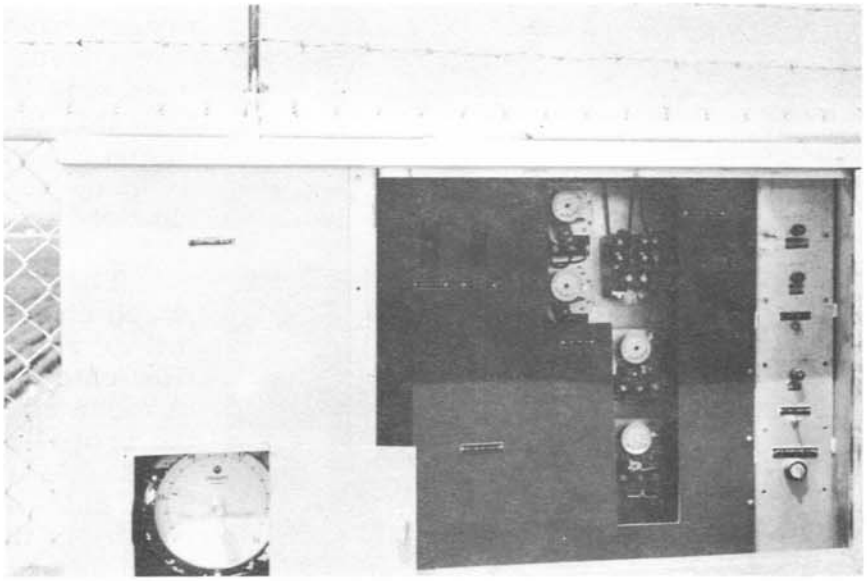
In order to use the device it was necessary to motorize the turnout gates at the head of the line with a reversible gear motor and provide suitable electrical control mechanisms. These include a system of timers which are connected between the selector and the head gate motor and whose function is to slow the flow change action so that the water hammer in the line and "hunting" of the gate may be eliminated.

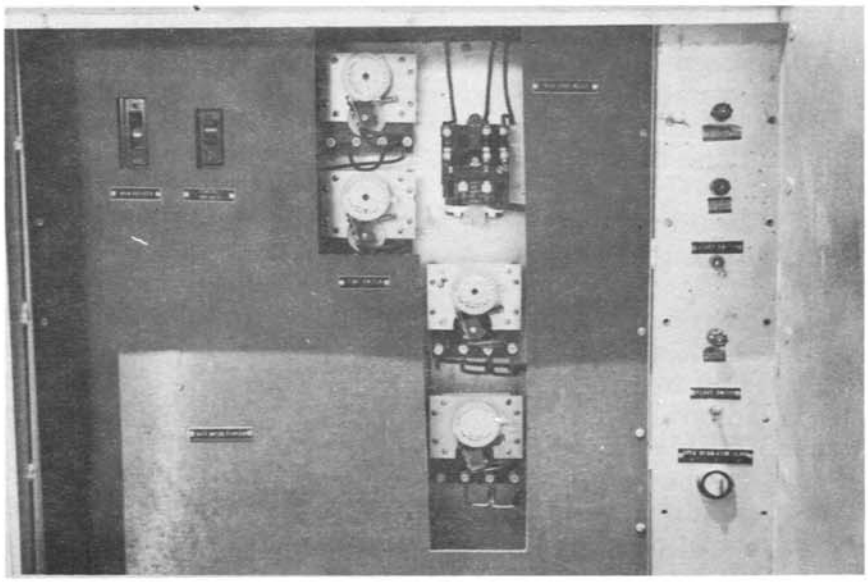


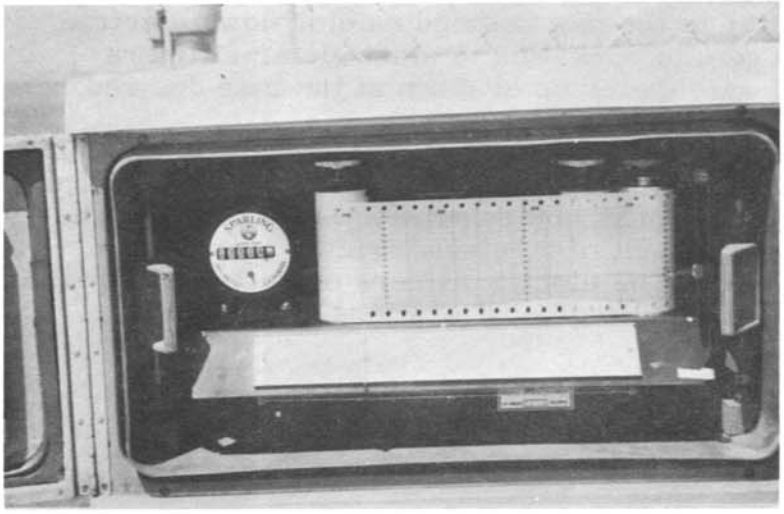
The photograph at left shows the face of the "Flow Rate Selector"

which in this instance allows a selection of from 0 to 75 cubic feet per second. By merely turning the pointer to the new desired rate of flow, electric impulses will immediately go into operation to start electric timers which in turn will start the gate motor up or down at the rate desired.

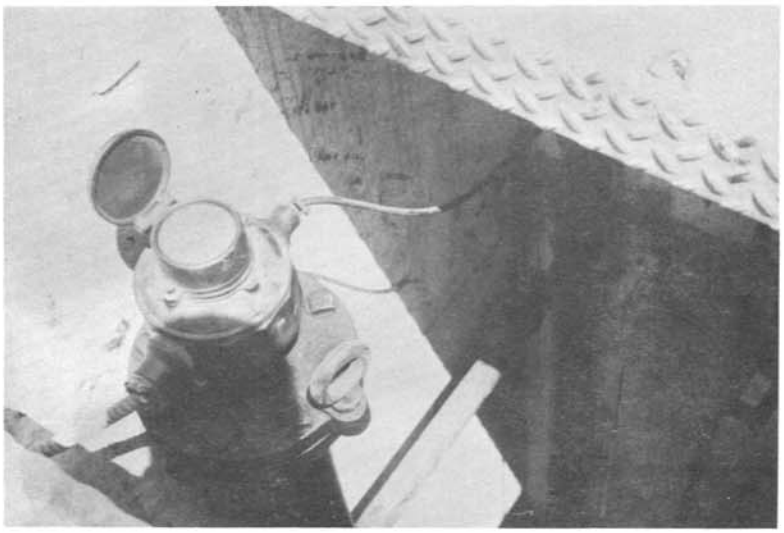
The upper photograph below shows the complete electrical control panel required for the installation, along with the relative positions of the flow rate selector, time clocks and controls. More detail of the electric timers and the arrangement of other electrical controls are shown in the lower photograph. The electric timers consist of two pairs of 1 rpm clocks which give wide latitude of operations.







The chart of a Sparling "Stript-o-graph" recorder, shown at left, provides a record of deliveries. Note the straight line to the left up until a short time prior to the time the photograph was taken. The straight line illustrates the accuracy of this mechanism in holding to a predetermined rate of flow. Near the right hand side of the chart note that the line is dipping in response to a change in the desired rate of flow.



The lower photograph shows the transmitter required for the flow rate selector which is mounted on the top of the propeller meter shaft. At the right hand side of the photograph, in the shadow, is an additional safety mechanism which will reduce the gate opening whenever the water level in the line should, by some failure, become too high. This may cause a "hunting" of the gate motor mechanism until repairs or adjustments can be made in the device but damage from flooding will be prevented should some mechanical failure occur during the night.

The District has not yet provided devices for the remaining three laterals serving the low pressure gravity system due to expense and the fact that they do not seem to present the operating problems encountered on the three laterals mentioned above. The total cost of materials for controlling the turnouts to two double-barreled laterals amounted to $2,530 in 1954. The labor, estimated to be an additional $800 for the two installations, makes a total cost of $3,330 or $1,665 each for the materials and labor.

The expenditures have more than been repaid in the labor costs alone. One man can now set the necessary change in flow required as well as the rate at which that change is desired in the line, and then go down

the line and make the necessary adjustments in deliveries to each individual farmer, without further manual manipulation of the head gate. Prior to the installation of these devices it was necessary for two ditchriders, equipped with mobile radios to make a change in the lateral. This procedure often took several hours to get the line in balance, and then the slightest change in canal level would require new adjustments. Ditchriders can now sleep at night without fear that these lines will get out of adjustment.

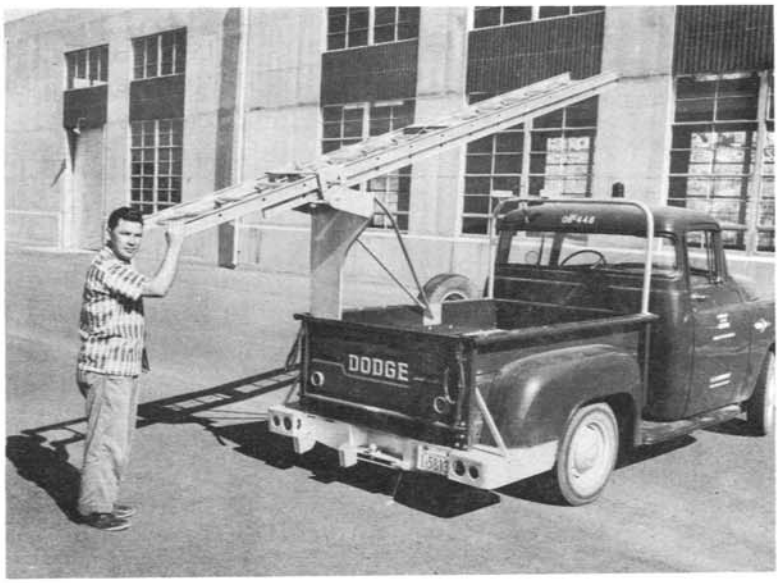
Maintenance

From time to time certain parts of this device become worn out and must be replaced. The principal replacement parts required are electrical roller switches which are operating continuously and, therefore, are subject to wear. The mechanism, however, from the District's standpoint has been very satisfactory as it has saved a large amount of labor, considerable anxiety on the part of the ditchriders, very low maintenance cost, and provided excellent service to the water users. The device has been in operation now for approximately four years, and there is no sign of general deterioration.

* * * * *

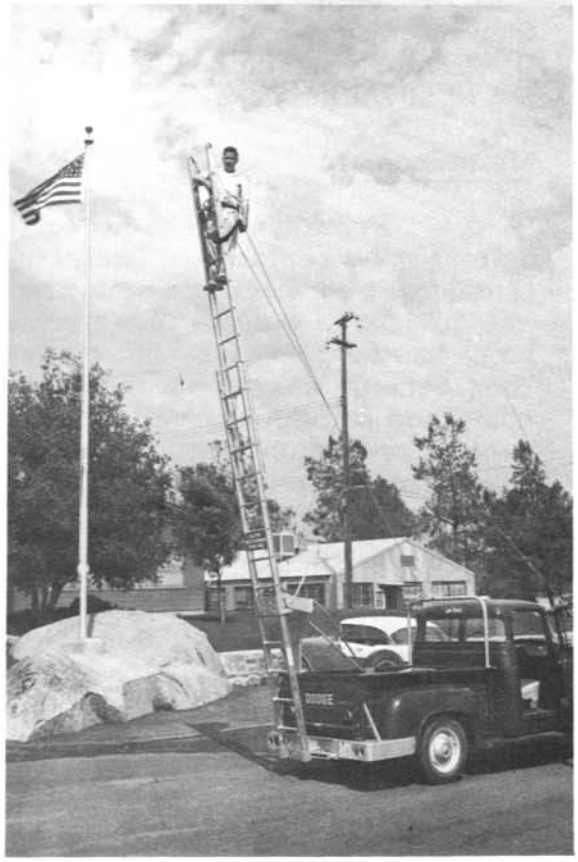
PICK-UP MOUNTED EXTENSION LADDER
(Suggestion R2-58-14)

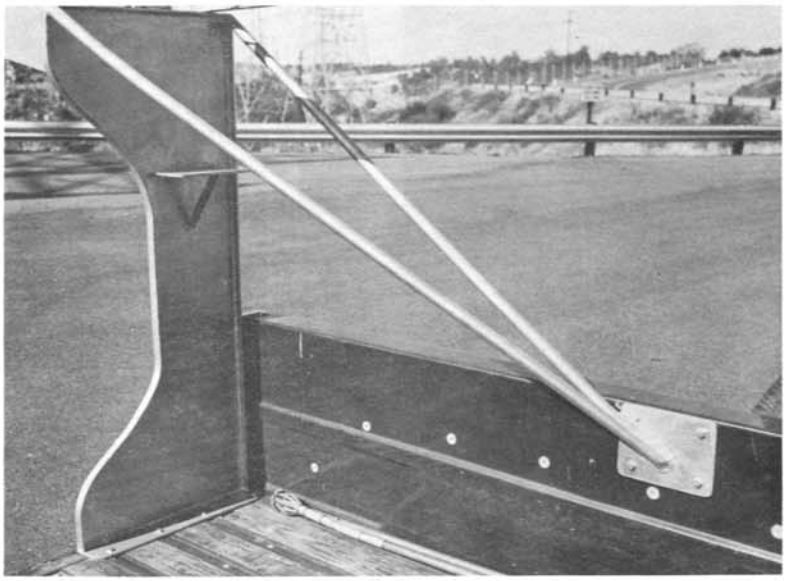
Folsom Operations employees Eugene H. Lee and Raymond G. Stroh, Central Valley Project, California, developed the ladder shown below for the purpose of changing lamps in street lighting and accomplishing other overhead work. The mounted ladder is designed for safety, convenience and time savings.



The installation consists of a regularly manufactured magnesium ladder built in to a hinged support so that it is readily operated into required positions. Due to the design of the support the ladder is not affected by hazardous weather conditions or irregular terrain. A spring loaded latching assembly mounted on the tubular supports at the front end of the truck bed makes it possible to readily position and secure the ladder for travel.

Several photographs of the ladder and mounting assembly illustrate its light weight, simplified mounting and use. Confining the support assembly to one corner of the vehicle also permits utilization of the vehicle for other services.





The main hinged support as shown at left provides for ease in installation and ready adaptability to other vehicles. In the upper left photograph, the main support bracket and lower socket are shown in more detail. The lower socket supports are fastened to the bumper of the vehicle.

The ladder is shown in the fully extended position in the photograph at upper right.

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WHAT'S THE MOST EXPENSIVE MISTAKE MADE IN.....
SERVICING DIESELS
LUBRICATION
TRACK MAINTENANCE

Servicing Diesels

Free Air Costs You Money If You Ignore Intake System

C. E. Martin of the Cummins Engine Company, says some contractors think that because air is free they can ignore the intake system of a diesel engine as long as the engine continues to run. This idea costs contractors plenty.

The most common and most costly mistake you can make when servicing diesels is to neglect the intake air system. Junk yards around the country are filled with engines destroyed by dirt that entered combustion chambers along with the "Free" air.

A diesel engine's intake air system demands two kinds of care: (1) the engine must get enough air to support complete fuel combustion; and (2) the intake air must be clean.

Consider the air requirements of a diesel engine. A diesel under a full load requires about 12,500 gal. of air for every gal. of fuel it burns. If the air supply is restricted, the engine looses horsepower, fuel is wasted, and lubricating oil is diluted. Air is free, yes, but the price you pay for air that an engine never receives because of restricted air intakes is very expensive.

Failure to keep intake air clean is even more disastrous to a diesel engine than a restricted air supply. All air contains abrasive dust particles. Mixed with lubricating oil, they make a very effective lapping compound that quickly wears metal from combustion chamber parts. In a short time, wear shows on pistons, rings, cylinders, and valves.

When air cleaners fail to function properly, or when there are leaks in the system, the life expectancy of a diesel engine is shortened substantially. On a dusty construction job, an engine with a normal life expectancy of from 6,000 to 8,000 hours, can wear out in less than 100 hours.

Five Ways to Assure a Clean Air Supply

Providing an ample supply of clean intake air is neither a difficult nor an expensive job. Here's what you should do:

1. Select the most effective air cleaner you can find and make sure that it has the capacity to meet your maximum filtering requirements. Generally, the equipment manufacturer has done this job for you.

2. Mount the cleaner out of the dirt stream. An intake extension, or snorkel, may be required on particularly dusty jobs.

3. Use heavy-wall, soft-rubber, or cuffed hose; seamless steel tubing; and airplane-type fittings to connect the air cleaner to the intake manifold. Make sure that all connections are absolutely leak-proof at all times.

4. Service the air cleaner regularly according to job conditions. Do not allow the element to become dirt-clogged. If the cleaner is of the oil-bath type, keep the oil container filled to the proper level and never allow dirt to build up more than 1/2-inch in the bottom of the cup. If the cleaner uses a dry-type paper element, make sure that the element forms a perfect seal. Replace it often.

5. Check hose and pipe connections often to make sure that all the engine intake air goes through the air cleaner. Air will not go through the cleaner unless it is forced to do so. Even a pin hole in a paper element or at a hose connection will let in enough dirt to ruin an engine before its time.

Air cleaner maintenance doesn't cost much, and it takes little time. Yet no other type of engine maintenance pays bigger dividends.

Contaminated Diesel Fuels Will Burn Up Your Profits

D. H. Briggs of the Detroit Diesel Company warns that diesel engines will burn anything from jet fuels to furnace oils. Just how well engines run on the various fuels available is subject to claims and counter claims of engine manufacturers.

But on one point they all agree--no matter what the fuel, it must be clean and free of water.

Fuel filters on diesel engines will trap most dirt particles if they are serviced regularly. But even the best filters cannot prevent water from passing into an engine if it is present in the fuel.

It takes only a little water to cause serious damage. If it is injected into the combustion chamber it reduces the engine's power output and causes it to run roughly. If water is left in fuel lines during a prolonged shut-down period, it will ruin the system. And in winter there is always the danger that fuel lines will freeze.

Improper storage and handling practices are the main causes of fuel contamination. Suppliers make sure that the fuel that they deliver to your job is in good condition. It is up to you to keep it that way.

Don't take delivery of fuel in the supplier's drums if you can avoid it. It is much better to have the supplier's tank truck pump fuel directly into a large tank. This cuts storage and handling requirements, and it lessens the danger of contamination considerably. Fuel delivered in this way is also less expensive.

Even less desirable than storing fuel in the supplier's drums is to store it in your own barrels or drums. Dirt and water are bound to collect in drums when they are re-used several times. Why contaminate fuels as soon as you receive them by pumping them into dirty containers?

If fuel must be stored in the supplier's drums, store them horizontally and protect them as much as possible from the weather. When drums are stored upright, water tends to collect on the tops of the containers. Soon it will seep into the barrels through the plugged openings.

When you keep fuel in barrels, store them with the outlets slightly higher than the rear of the containers so that sediment and water settle out.

When fuel is kept in a big storage tank, make sure that newly delivered fuel is allowed to settle out before it is used. This takes about 24 hours. To prevent water from building up through condensation drain the tank periodically.

Be Sure Your Mechanics Know Why Maintenance is Important

W. M. Dietrich of the International Harvester Company says diesel engine maintenance is a highly specialized skill, and the men who work on diesels must be well qualified. Contractors make a very big mistake when they fail to place responsibility for engine maintenance in the hands of competent mechanics.

Knowing how to follow manufacturer's recommendations is not enough. It is also important to know why you perform a maintenance operation.

This is because a workable maintenance program is necessarily one that is flexible. It takes a well-trained supervisor to recognize conditions that require, say, more frequent oil filtering servicing. Untrained men simply do not have the experience to adapt manufacturers' recommendations to meet the needs of a particular job.

Manufacturers' recommendations for air cleaner maintenance usually say they should be checked "daily or more often," depending upon operating conditions. When a fleet works in heavy dust, cleaners may need servicing several times a day. No contractor can afford to have his maintenance men learn this important lesson after his fleet has worked in dust for several days.

And then there is the inexperienced man who decides to do the boss a favor by "setting up" the power on a diesel. As any good maintenance man knows, this attempt to reach "peak" performance actually reduces production over the long haul because it leads to increased downtime.

All diesel engines are adjusted carefully at the factory to provide a proper balance between maximum output and long and economical service. When you adjust an injection pump to make it deliver more fuel, the result is incomplete combustion. In a short time, this leads to carbon deposits, lube oil dilution, and excessive fuel consumption.

You can also expect trouble when an inexperienced man sets up the governor control to over-speed an engine, or when he changes the timing. A poor mechanic sees only the slight extra horsepower he gains from these modifications; an experienced man knows that in the long run this type of meddling only means more downtime and shorter engine life.

Lack of full understanding of the reasons behind manufacturers' maintenance recommendations can cause untimely breakdowns. The way to avoid them is to have well-trained maintenance personnel.

Engine Performance Depends on Condition of Air Cleaners

P. H. Van Osdol of Allis-Chalmers warns that the most expensive mistake a contractor can make is to fail to appreciate the importance of regular and proper maintenance of pre-cleaners and cleaners.

No matter what other care you give a diesel engine, the condition of its pre-cleaners and cleaners determines in a large measure just how much effective service you can expect it to deliver.

The importance of air cleaner maintenance is brought home sharply when you realize that a diesel engine in a large crawler tractor requires the equivalent of 20 tank-car loads of air an hour. It is obvious that devices designed to filter this huge quantity of air must be properly serviced.

Dust contaminates all the air around us to varying degrees, and, no matter how fine it is, all dust is abrasive. Because the amount of dust present in the air varies with your job location and operating conditions, the proper intervals between air cleaner maintenance depends on your day-to-day operation. On one job, air cleaners might need only

weekly servicing. On another job, or even at a different time on the same job, it might be necessary to service cleaners several times a day.

Air system maintenance does not end when dust and debris are removed from the pre-cleaner, or when the oil in the air cleaner cup is changed. A really effective check should also include an inspection of hose, hose clamps, and other components for leaks or obstructions.

All Air Cleaners Are Not the Same - Another mistake that many maintenance men make is to assume that all cleaners are alike. The air cleaner systems on most engines are similar in construction and arrangement, but they are by no means identical. The only effective maintenance is thorough maintenance, and the only way to service an air cleaner properly is to know it thoroughly. If you are servicing a cleaner on an engine that is not entirely familiar to you, check the manufacturer's manual.

Proper air cleaner maintenance pays big dividends because the engine operates more efficiently on less fuel. Also, an engine with effective cleaners requires fewer overhauls. Finally, and most important, good air cleaner maintenance cuts downtime.

Keep Hands and Tools Clean When You Service Diesels

V. A. Woodling of Caterpillar says that dirt is a diesel engine's mortal enemy. The biggest mistake a contractor can make is to fail to keep it out of his engines.

Consider the conditions under which a diesel must work in the field. It is virtually surrounded by dust and dirt and yet it requires huge quantities of fresh air--about 3 cubic feet per minute for every horsepower it develops.

Engine manufacturers equip their products with filters, seals, and other equipment designed to keep an engine as clean as possible. All of these assemblies must operate at close to peak efficiency. The way to keep them in this condition is to service them as recommended--frequently and properly.

Even when these components are serviced at recommended intervals, you can still be responsible for dirt if the job is not done properly.

When servicing air cleaners, don't overfill the oil cup. This practice gives no added protection; it actually reduces a cleaner's efficiency because excess oil may be pulled over into the engine. And, don't stop when the oil cup is cleaned; check screens frequently and blow them out periodically.

Oil filters perform a big job. Only filters that are properly serviced can prevent sludge and abrasives from building up. Don't just slip in a new filter; first wash, drain, and clean the filter housing.

There is another way--beyond the control of the manufacturer--that dirt enters an engine. All too often, it is carried there by a well-meaning maintenance man.

The best filtering and sealing devices cannot keep dirt from an engine when it is carried there by dirty tools or hands, or when a dipstick or drain plug is not wiped clean. It can enter with fuel that has not been allowed to stand until dirt settles out. It can even enter an engine when the mechanic installs a "new" filter that has been out of its original package long enough to pick up dirt or dust.

Make Major Repairs In A Clean Shop - Much too frequently, major repairs are made in the field. Sometimes this practice is necessary, but making repairs in the field is a good way to introduce dirt into an engine. This is because you cannot clean parts thoroughly in the field and keep them clean during assembly. Adjusting valves near a dusty haul road, for example, provides dirt with an engraved invitation to enter the engine.

If emergency repairs must be made in the field, it is a good idea to change filters and lubricating oil within 50 hours after a machine returns to service. But it is an even better idea to do major engine repairs in a well-equipped, clean shop.

Lubrication

Don't Pass Up Extra Services That Oil Companies Provide

Contractors make an expensive mistake, says H. G. Rudolph of Socony-Mobil Oil Company, when they fail to take advantage of the extra services that petroleum suppliers make available to them.

We in the oil industry are well aware of our responsibility to our customers. Our main aim is not only to produce good products, but to help you select the right lubricant and apply it properly. Only in this way can you obtain maximum equipment life at the lowest possible operating cost.

Complete Program Serves Contractors - Socony-Mobil has a complete program for the contractor. Our first step is to survey your equipment to determine your requirements. This is a valuable service because it enables you to keep lubrication inventories at a minimum.

This reduces storage requirements and lessens the possibility that the wrong lubricant will be applied to the wrong machine.

Our next step is to help you establish good storage and handling techniques. Unless petroleum products are stored and handled properly, the effectiveness of even the best lubricants is impaired by contamination. This results in an unnecessary addition to operating expenses, and one that is easy to avoid.

Your lubricant supplier also will help you establish this information in the form of charts that cover the operation of each machine. The charts show the types of lubricants a machine needs, the proper places to apply them, and the proper intervals between servicing.

Equipment manufacturers base their lubrication recommendations on normal operating conditions. On-the-job experience and technical data obtained from laboratory analyses of used oils often show that these recommendations should be revised to conform to actual job conditions.

Lubrication field engineers are experts at evaluating needs in the light of working conditions. Their help in establishing proper schedules can be invaluable to you.

Make Lubrication Time Also Inspection Time - Socony also has available an easy-to-use Preventative Maintenance Control System. This system, which is based on the premise that lubrication time should also be inspection time, is built around five forms:

(1) A record folder contains a permanent record of each machine.

(2) An equipment recommendation car lists lubricant requirements and other special needs.

(3) A weekly service and inspection report serves as a check sheet of work to be done.

(4) A delivery ticket shows the products used in each machine.

(5) The operator's "squawk-sheet" enables him to point out conditions that need immediate care.

Take advantage of these services. Today's equipment fleets are a complex assortment of expensive machinery. To get the most out of them, you need all the technical assistance you can get.

Expect Trouble When You Use the Wrong Type of Engine Oil

J. H. Coover of D-A warns that the most expensive--and also the most common--mistake a contractor can make is to use the wrong lubricating oil in diesel engines.

Engine oil specifications for today's high-speed supercharged or turbocharged diesels do not leave much of a margin for error. They must be followed faithfully if you want to operate diesel engines economically for long periods.

Engine manufacturers make detailed recommendations as to the types of lubricating oils that you should use. Four types of oils--Mil-L-2104, Supplement one (S-1), Series 2, and Series 3--cover their recommendations.

Generally, manufacturers' recommendations are based on two important factors:

(1) Sulfur content of fuel used in a diesel.

(2) The conditions under which the machine is to operate.

For example, one manufacturer specifies a Mil-L-2104 lubricating oil for its engine if the sulfur content of the fuel is less than 0.4 per cent or if the engine operates under a heavy load. But if the sulfur content is above 0.4 per cent, this same manufacturer recommends an S-1 oil.

Another engine manufacturer recommends that its engines be operated with a Series 3 oil. This is because these particular engines benefit from the extra detergent action of Series 3 oil.

Don't Get in a Rut With Diesel Lubricants - Habit is one reason some contractors ignore manufacturers' engine oil specifications. Many times we have run across a contractor who has used, say, Mil-L-2104 oil in many of his engines with good results. So instead of changing his oil type to meet the needs of a specific engine, the contractor decides to stick with the oil he has used for years.

Yet experience teaches us that as diesel engines change, so do their lubricant requirements. Using the wrong oil can only mean accelerated engine wear.

If you think you are getting good service from an oil that is not the type recommended for a specific engine, check with others in your area who are operating the same type of machinery.

If your neighbor is using recommended oils, I think you will be amazed at the longer, trouble-free service he is getting out of his engines.

I know of a case where one contractor is getting up to 8,500 hours of service from engines between overhauls. Another contractor in the area must overhaul his engines every 3,500 hours. The engines are the same and so are the operating conditions. The difference? One contractor is using recommended oils only; the other is using his "old stand-by" oil.

The way to get more service from your engines is simple. Follow the diesel engine manufacturer's recommendation to the letter, and make sure you purchase your oil from a reliable firm that can supply you with the proper lubricants.

Three Other Mistakes That Cost You Money - I would say that using the wrong engine oil is the most expensive mistake you can make, but I can think of three other mistakes that contractors make all too often. And all of them are very costly, very common, and very easy to eliminate.

These are: (1) Servicing air cleaners improperly and irregularly; (2) Using a chassis grease instead of a semi-fluid lubricant on those track roller assemblies that need a free-flowing lubricant; (3) Using the wrong type of gear lubricant (usually one that doesn't contain proper extreme-pressure additives).

Steer clear of these mistakes, too, simply by following the manufacturer's recommendations closely. Manufacturers spend considerable time and money to determine the proper way to maintain a piece of equipment. It is folly to ignore or modify their recommendations. To do so is to invite trouble.

Changing Lubricants on Time is Only Half the Job

J. G. Keller of Esso believes failure to set up and follow a proper lubrication schedule is the most expensive mistake a contractor can make. This sounds fundamental, but by a "proper" schedule I mean a lot more than just changing lubricants at the intervals set down in a maintenance manual.

It is impossible to separate lubricant scheduling from those other factors that have a direct bearing on lubricants. A good schedule depends upon the maintenance of auxiliary equipment, the conditions under which a machine must operate, and the type of lubricant used.

No matter how often lubricants are changed, the best of them suffer needlessly when you ignore auxiliary equipment that is designed to keep an engine clean. These components include air cleaners, lubricant filters, and dust caps, among others.

Cleaners and Filters Determine Oil Life - Most of you realize the importance of servicing these components regularly. Yet, when time is at a premium, it is just this type of auxiliary equipment that often is asked "to wait 'till next time'" for servicing. As a result, the likelihood of lubricant contamination--and engine damage--is greatly increased.

Most manufacturers' maintenance recommendations are meant for machinery that is used under normal operating conditions. But as you all know, it's seldom that construction equipment operates under anything close to "normal" considerations.

Adverse operating conditions that contribute to abnormal contamination of crankcase oil include temperature extremes, high dust concentrations, and frequent overloading. Similarly, when a machine

must work in mud or water it places a greater than normal burden on greased parts.

You must adjust the length of time between lubricant changes to compensate for adverse operating conditions. This also applies to the frequency with which you inspect and maintain air cleaners and oil filters.

Change Lubricants at the Right Time - You are well aware of the need for changing viscosity and consistency grades as seasonal changes in temperature occur. All of you get around to making these changes, but our records show that many fail to make the proper lubrication changes at the right time.

These changes in seasonal conditions must be anticipated. Change lubricants soon enough so that you have the proper grades in use when temperature changes occur--not after they occur. Changing viscosity and consistency grades too late is like shutting the barn door after your horse has run away.

I can't over-emphasize the importance of carrying out a consistent lubrication schedule. By a consistent schedule, I mean one that is consistent with operating conditions. A good lubrication schedule must stress flexibility, foresight, and adaptability. It should not be considered a routine, standardized operation that cannot be modified to meet job needs.

Our records prove conclusively that large savings in both time and money are the rewards of a good lubrication schedule. These are attractive incentives.

Contaminated Lubricants Are Equipment's Worst Enemies

The most expensive mistake a contractor can make, says F. W. Minor of Sinclair, is to use lubricants--whether they be greases, motor oils, or gear oils--that are contaminated.

Dirt and water can ruin the best lubricants. For this reason, you must be on your guard against contamination from the time you break the seal on the lubricant container.

I can tell a good maintenance man when I see him go out of his way to use clean oil containers or grease guns to transfer lubricants from drums to a piece of equipment.

To me, he earns his "doctor of lubrication" degree when he also cleans the equipment part before he applies a lubricant. And this includes oil fill openings as well as grease pressure fittings.

More failures of anti-friction and plain bearings are caused by dirt than by any other reason. A leading engine bearing manufacturer

estimates that more than 42 per cent of premature engine bearing failures are caused by dirt. The expression, "cheap as dirt" surely has no application when you talk about lubricants.

Water makes a fine cleaning agent for some jobs, but keep it away from lubricants. It takes only two-tenths of 1 percent of water to degrade the best heavy-duty oil or extreme-pressure gear lubricant. And it makes little difference whether this contamination happens while the lubricant is in storage or when it is in actual use.

If at all possible, store lubricants indoors, preferably in a room with fireproof brick or concrete walls or floors. If lubricants must be stored outdoors, place the drums on their sides on racks. Don't lay them on the ground.

If drums are stored in an upright position outdoors, rain water may accumulate around the rims of the drums. In a short time, the natural breathing action of the drums, resulting from changes in temperature, will cause them to absorb some of the water. If drums must be stored temporarily on end outdoors, cover them with canvas.

Lubricants will eventually become contaminated in service. The contaminants can be metal chips from wearing parts, water or dirt that enters the crankcase through the air intake and the crankcase ventilating system, or dirt entering the crankcase through ineffective seals. The best way to eliminate this kind of lubricant contamination is to stick close to recommended maintenance schedules.

In relation to the capital investment for construction equipment, the cost and time needed to store, handle and apply lubricants properly is small. Yet the successful use of an earthmoving fleet depends in great measure on how well lubricants perform.

Track Maintenance

You'll Pay a Heavy Penalty for Poorly Adjusted Tracks

International Harvester's F. H. King says track tension adjustments, the simplest part of track maintenance, can be most expensive if you neglect it. The life of track components--rollers, idlers, and sprockets--depends on proper track adjustment. So does the performance of the entire machine.

Tight Tracks Steal Engine Horsepower - Loose chains come to mind immediately when you talk about track adjustments. But tight chains are equally harmful, and you'll find them on a job more often than you might think. Tight tracks cause loss of power. Machines equipped with tracks as tight as banjo strings can barely move in the higher gears. Some experts estimate that tight tracks can absorb up to 90 per cent of the engine's power.

Where does this power go? When chains are tight enough, they preload the front idler recoil mechanism and cause the track pins and bushings to bind. Instead of flowing smoothly over and around the rollers and idlers, the track is dragged across under protest. This creates power-absorbing friction and accelerates wear on all surfaces.

Chains only slightly tight also can be costly. You don't have to look far to find a serviceman who has investigated a complaint of poor engine performance and learned that the cause of the trouble was tight chains.

I know of one extreme case in which a contractor went to all the trouble and expense of having an engine and injection pump overhauled. Later he learned that what really was needed was a simple track adjustment.

Inaccurate adjustments, of course, will cause tight tracks. Or tracks may tighten up while the machine is operating. Certain types of fine soils will pack between the pins and bushings, removing the slack from the assembly. When this happens, you may have to adjust the chains so that they are loose enough to obtain normal running clearance. If one inch is the specified slack, adjust to approximately 2 inches in soil that packs. And check the adjustment frequently.

Loose Tracks Cause Rapid Wear, Downtime - An excessively loose track has a tendency to come off whenever the machine pivots, operates on side slopes, or backs up an incline. Replacing a thrown track is a backbreaking, time-consuming job. All operators try to avoid it. But an operator may concentrate so intently on keeping the track in place that his production suffers.

Even if a track is not loose enough to come off, it still may deflect to the side and cause abnormal wear on the roller flanges, sprocket teeth, and on the sides of the links.

Loose chains also tend to whip at high tractor speeds. The whipping motion creates severe impact loads on all running gear parts. If you don't make the proper adjustment, you soon will have an expensive repair job.

Periodic Adjustments Take Little Time, Effort - You should make a thorough track inspection at least once a week. Whenever the slack is more or less than the dimension specified in the operator's manual for the machine, you should make an adjustment.

Hydraulic adjusters, now standard equipment on several tractors, take the muscle work out of track adjusting. But manual adjustments are almost as easy to make if you keep the moving parts well lubricated.

To make an accurate adjustment, concentrate all the slack in the upper portion of the track. Do this by placing a 12-inch wood block beneath the front grouser. Then, with the tractor in low gear, engage the clutch until the track tightens along the ground and around the sprocket. Shut off the engine, lock the brakes, and stand on the track to depress it at the point of measurement--usually between the track idlers. Then lay a straightedge across the top of the grousers and measure the slack.

Why pay the penalty for tracks that are too tight or too loose when good preventative maintenance takes comparatively little time and effort?

It's a Sound Investment to Rebuild Track Components

C. B. Borho of the Caterpillar Company makes the point that the most expensive mistake an owner of a track-type machine can make is to assume that such an uncomplicated mechanism as a crawler track needs no care. That's as wrong as it can be.

The modern track group is the result of long research. An effective service life is built into it. But without proper care it's life may be short.

Be Careful with Lubricants - One major element in any good maintenance program is lubrication. And you have to be careful how you apply lubricants. If you use a hand-operated volume compressor to grease roller and idler bearings, apply only enough to cause a slight resistance on the compressor handle.

Pumping after you feel this slight resistance will create enough hydraulic pressure to damage the seals. If you can't build up this slight pressure on the handle, the chances are a seal has been damaged. You should replace it as soon as possible.

When you use a power-operated pressure lubricant dispenser, be sure the dispenser is equipped with a relief valve in the lubricant line. Otherwise the dispenser may build up enough volume and pressure to injure the seals. Be sure the relief valve has the proper initial setting and check it often. Rollers sometimes go without lubricant because the valve unseats at too low a pressure.

Keep Tracks Properly Adjusted - Improper track adjustment also can shorten the life of your crawler track assemblies. If the track is too loose it may be thrown off. That means certain downtime and possible damage to the parts. A loose track also allows additional movement of the contacting surfaces and increases wear to its parts.

If the track is too tight, your problems will be even more serious. Tight tracks set up stresses that accelerate wear on pins and bushings and make it more difficult for the system to accommodate

rocks and other material that may work between the track. Moreover, there is a progression of stresses on links, idler and sprocket shafts, and final drives.

The solution to the problem of improper track adjustment is simple: Check frequently to make sure each track is in proper tension.

Nuts and bolts, like other components of the track require some attention. Track shoe bolts work loose when a tractor works on rock, or makes very heavy pulls, or when the track is allowed to spin or turned sharply at high speeds.

End collar bolts may work loose when subjected to continuous shock loading. Field experience shows that the inside end collar bolts seldom are checked for tightness. If you don't tighten these bolts periodically, the seals will loosen, and the roller will fail from lack of lubricant.

Keep track hardware tight. This requires time and supervision. But the payoff is production from machines that are on the job--not in the repair shop.

The introduction of the large pusher tractor has brought some special track problems. Some of the big pushers are wider than some older makes of scrapers. When this is the case, the outer edge of the tractor's track shoes will ride out of the scraper cut, forcing the track in toward the tractor. The result is accelerated wear to sprockets, idlers, rollers, and other track parts.

Narrow shoes are an answer to this problem. But if you need flotation, you should put on offset shoes that match the cut of the narrowest scraper on the job.

Rebuilding track is a sound investment. Track rollers, for example, can be rebuilt to almost original equipment specifications for about half the cost of a new assembly.

The trouble is that many contractors let track components wear past the most economical reconditioning time. Checking the amount of life left in an assembly should be part of the routine inspection. You can learn what the wear limits for track components are from your dealer. It's just a matter of good business to rebuild track parts in time.

Don't Replace Track Chains But Neglect other Components

J. P. Carroll of Euclid says the most expensive mistake a contractor can make in maintaining track assemblies is to install new chain assemblies without reconditioning or replacing the track rollers, front idlers, and sprokets.

In a worn track system, the link rail cross-section is worn convex; the roller and idler rims are worn concave. The sprocket teeth wear so as to conform to the irregular bushing contour and to accommodate the elongated chain pitch.

If you replace a worn out track chain without reconditioning or replacing the related parts, you will shorten the life of the new link rail surfaces. The rails will have edge contact with the rollers and idlers. This will cause high unit pressures, premature edge wear, and cracking.

You also can recondition sprockets by hard face welding, but generally it's good practice to replace sprockets. Some sprockets are of bolt rim design; others comprise the hub as an integral part and may have a sprocket rim replacement welded in place after the worn section is burned off.

In many cases you can salvage the track chain for extended life before replacement by turning the bushings and hardfacing the link rail surfaces. Here again, you should recondition the rollers and idlers and replace the sprocket.

Crawler track system parts are expendable, but intelligent maintenance will give you maximum life at the lowest cost per hour.

Too Many Contractors Think Crawler Tracks Must Be Tight

Improper track chain tension, warns W. A. Smith of J. I. Case, can cost you plenty. Too many contractors and operators think the track must be tight or it will be thrown off. This is a mistaken idea--and a very expensive one.

You should adjust crawler tracks to the proper tension just as you maintain the correct air pressure in the tires of your wheeled vehicles.

Loosen Tracks Working in Mud - What track tension is proper depends on the type of material in which the machine is working. For example, when a tractor is operating in material that has a tendency to pack, such as mud, wet sand, or snow, the tracks should be a little loose. This will allow the track chain to flop as it goes around so that it shakes out the sticky or packed material.

If you don't keep the track a little loose, material will pack between the chain and bushings, track tension will build up, and you're in for trouble. The sprocket may jump on the bushing; you'll get excess strain on the final drive bearings and on the front idler bearings; and there'll be excessive wear on the internal bushings or the track pin.

Tight tracks also put excessive strain on the front idler bracket. This strain is transmitted through the adjusting bolt back to the buffer or recoil spring. It can damage the bracket, and the spring may break because it will not be able to retract and absorb shocks.

When tracks are too tight there also is an unnecessary strain on the drive assembly. The engine will lug excessively, and the fuel consumption will be high.

Tighten Tracks When Ground is Rocky

When your tractor is operating on rocky or uneven terrain, you should maintain tighter track tension. Tightening up a little will allow the track chain to bridge over the rough terrain. The weight of the machine will be distributed over a greater area of the track rather than concentrated on one or two track pads and rollers. This, of course, will add greatly to the life of the track chain and suspension system.

Track adjustment also is necessary to maintain proper alignment of the rails with the driving sprocket and the front idler wheel. If you maintain this alignment, the sprocket will ride on either the inside of the outside track rail, causing chipping or wear on that particular rail. You'll also get excessive wear on the sprocket itself. And if you neglect to adjust the track for proper alignment, the tractor may throw the track chain when operating at high speeds.

I'm convinced that the greatest expense of any crawler tractor operation is maintenance and repair of the track chain assembly. This is partly because of the rugged type of operation that track-type equipment is subjected to and partly because of the characteristics of track chain construction.

In the track you have metal-to-metal contact of the track pin to the bushing, the bushing to the sprocket, and the track rail to the track roller. Any time you have a metal-to-metal contact without a lubricant, you are going to have wear.

The operator should clear the track suspension regularly. This will remove abrasive material from the inner track links, and the track will live longer. Sand or dirt trapped within the track act as a grinding compound when the track is in motion. It will eat out track material wherever there is one of these friction areas. Proper track tension will go a long way to help keep the track clean.

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VALVE SEALING APERTURE
(Suggestion R1-56-158)

In the past, trouble has been experienced on the Roza Division of the Yakima Project in priming the irrigation pumps at those pumping plants where the discharge line has been drained. Original design provided for a main discharge line valve which could be closed to seal off the pump and permit priming. However, valves which have become worn will not seal off the line and pumps cannot be primed if there is no water behind the valve to seal it off. In such a case, an auxiliary pump must be brought in to pump water from the canal behind the valve; or if this is impossible, it has been necessary to dismantle the valve, grease it well to seal it, reassemble it, and then prime the irrigation pump.

This spring, Zeb. K. Howell, Pumping Plant Mechanic on the Roza Division, suggested that regular 5" pipe couplings be welded into the pump discharge lines, close to the valve on the discharge side. Under ordinary circumstances, this coupling would be closed by an ordinary 5" pipe plug. When it is necessary to seal the discharge valve, the plug can be removed, and the opening is sufficiently large to insert grease by hand to seal the valve. The plug can then be replaced and the pump primed.

The couplings and plugs were installed at 8 pumping plants, and the installation made it possible to easily prime the pumps. Further installations are now planned for each of the 17 pumping plants as time and work schedules permit. The priming problem always occurs at the beginning of the irrigation season when the discharge lines are drained, and may occur at any time during the irrigation season when discharge lines are drained because of power or pump failure. Now one maintenance man, with the grease which is normally carried, can rectify the trouble immediately.

A drawing on the following page shows the schematic arrangement of the pipe coupling with reference to the valve and discharge line.

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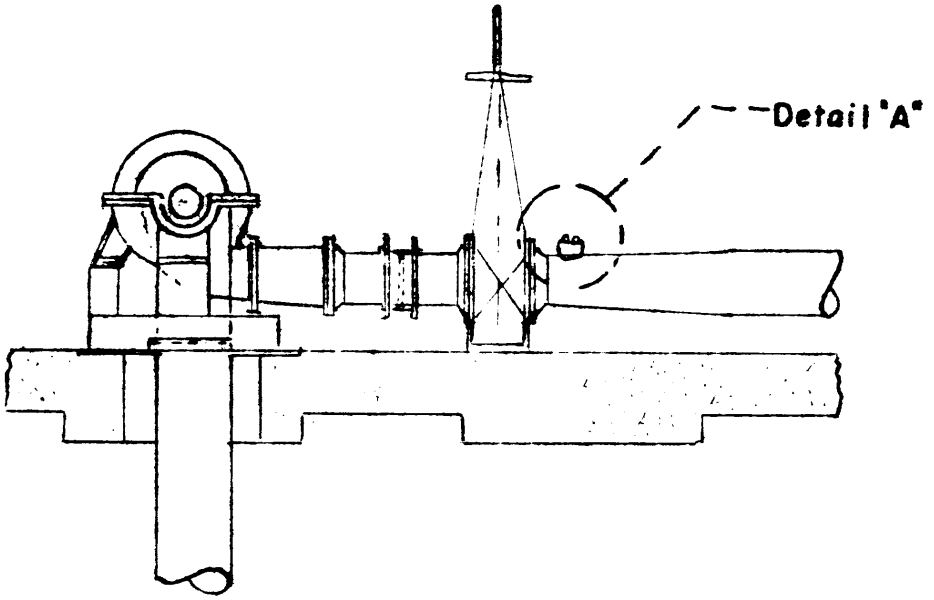
VALVE GREASE SEALING APERTURE

YAKIMA PROJECT- ROZA DIVISION



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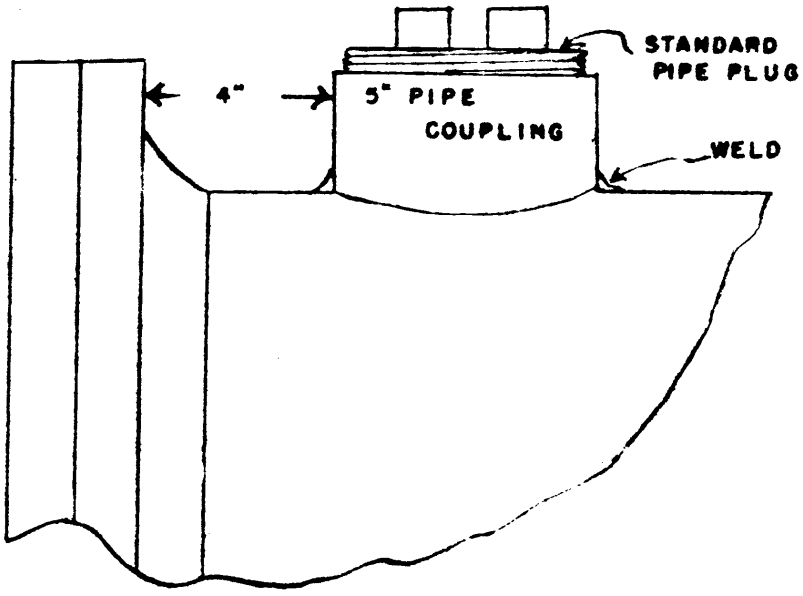

DETAIL "A"