THE PENNSYLVANIA RAILROAD

MANUAL OF INSTRUCTIONS
MAINTENANCE OF WAY EQUIPMENT

M. W. 52
THE PENNSYLVANIA RAILROAD

MANUAL OF INSTRUCTIONS

MAINTENANCE OF WAY EQUIPMENT

M. W. 52-(D)

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Issued 1/1/60
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To

Supervisor

This to acknowledge receipt of M. W. 52-(D) - Manual of Instructions, Maintenance of Way Equipment.

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INDEX

Adjustments and Repairs to Machinery 23-32 & 83

Adzers, Tie 300-318

Air Compressors, Crawler-type 361-366

Air Compressors - Operation 367-390

Air Compressors - Testing and Repair 370-390

Air Filters 30

Air-operated Side Dump Cars 850-864

Antifreeze Solution 76-80

Attachments for Grinders 1720-1728

Automobiles, Autotrucks, Auto Trailers - General 7200-7206

Autotruk Cranes 1100-1169

Autotruck-mounted Earth Borers 1400-1410

Autotrucks - Detachable Snowplows 4080

Ballast Cleaning Moles 670-676

Ballast Distributors 640-645

Ballasters, Power - Pullman 400-410

Ballastex - Nordberg 510-517

Ballast Leveler (Part of Boxcar-type Flanger) 904-908

Ballast Regulators 620-626

Ballast Shaper, Drainage Car and Scarifier 650-657

Batteries, Storage 118-124

Boilers, Steam 700-703

Bonding Drills - Power 1350-1360

Borers, Earth - Mounted on Autotruk or Tractor 1400-1410

Borers, Tie 1450-1459

Brownhoist Ballast Cleaning Machines 600-605

Buckets - Clamshell, Orange Peel, Dragline and Dipper Sticks 750

Bulldozers 7100-7127

Burners, Weed 7400-7415

Cables, Wire - Installation and Care of 800-825

Cars, Air-operated - Side Dump 850-864

Cars, Flanger (Boxcar-type) 400-908

Cars, Motor 1000-1014

Cars, Rail Grinder 920

Cars, Spreader - Jordan 5050-5070

Cars, Track 1000-1014

Cement Guns 1220-1225

Chains, Lifting 800-825

Clamshell Buckets 750

Cleaning of Machines 22

Clearance Gauges 6

Compressors, Air - Operation 350-360

Compressors, Air - Testing and Repair 370-390

Compressors, Crawler-type 361-366

Concrete Mixers 1200-1209

Conveyors Portable 1250-1255

Cooling System 73-81

Crane 1100-1169

Cranes, Autotruk 1100-1169

Crankcase - Flushing 70

Crawler Tractors 7100-7127

Cribbers (Kershaw Wheel-type) 520-531

Cribex Machines (Nordberg) 500-508

Cross Grinders, P-11 and P-11-S 1730-1733

Diesel Engines 250-263

Dipper Stick Buckets 750

Dieses 1300-1308

Dragline Buckets 850-864

Dragline, Ballast Shaper, Scarifier 650-657

Drills, Rail and Bonding 1350-1360

Drivers, Pile 3000-3015

Dump Cars, Side - Air-operated 850-864
Earth Borers - Autotruck or Tractor Mounted... 1400-1410
Electric Generators.......................... 1500-1522
Electro-Magnets.............................. 2000-2013
Engines, Air-cooled - Gasoline.............. 200-205
Engines, Gasoline - General Tune-up........ 100-182
Filters, Air...................................... 30
Filters, Lube Oil.............................. 31
Flangers (Boxcar-type)....................... 900-908
Flexible Shafts and Attachments............. 1720-1728
Flushing Crankcase............................ 70
Freezing of Cooling System................... 76
Grinders......................................... 1700-1707
Fuel Handling................................. 35-36 & 61-62
Fuel Tanks...................................... 41, 84
Gasoline Engines - General Tune-up...........
&
Gasoline Mixture............................. 65, 71, 87
Generators, Electric......................... 1500-1522
Generators, Welding......................... 1550-1556
Graders - Motor or Road Patrol............ 1600-1614
Grinder Attachments......................... 1720-1728
Grinder, Cars, Rail........................... 920
Grinders, Flexible Shaft - Nordberg...... 1770-1775
Grinders, Flexible Shaft - P-22 and P-44.. 1750-1764
Grinders - General......................... 1700-1707
Grinders, Joint - Cross - P-11 & P-11-S... 1730-1733
Grinders, Switch and Stock Rail - Portable -
  P-16........................................... 1740-1744
Grout Machines - Hydraulic.................. 1810-1817
Grout Machines - Pneumatic.................. 1800-1807
Guns - Cement.................................. 1220-1225
Hammers - Steam.............................. 3000-3015
Hand Signals for Hoisting Equipment........ 1158
Highway-Rail Vehicles....................... 1050-1068
Hydraulic Systems............................ 270-289
Idle Machinery.................................. 34
Ignition Switch - Not Stopping Engine...... 72
Impact Wrenches.............................. 8580-8583
Inspection of Machinery..................... 20 & 46
Jacks, Tamping - Kalamazoo "Handyman"... 1930-1946
Jacks, Tamping Power - Nordberg........ 1920-1929
Jacks, Track - Power (Nordberg).......... 1900-1913
Jackson Track Maintainers................. 420-436
Jordan Spreader Cars......................... 5050-5070
Locomotive Cranes............................ 1100-1169
Lubrication - General....................... 8800-8815
Lubrication of Four-cycle Gasoline Engines 69
Machinery Not in Use......................... 33-34
Machinery Record Number Plates........... 7
Magnets......................................... 85
Magnets, Electro.............................. 2000-2013
McWilliams Multiple Tampers............... 450-459
Mechanical Spike Pullers - Nordberg...... 5000-5011
Milling Machines, Rail - Power........... 2030
Mixers, Concrete.................. 1200-1209
Mixtures of Gasoline to Use............... 71
Moles, Ballast Cleaning.................... 670-676
Mowers, Weed - On-track................... 2070-2073
Mowing Machines - Off-track.............. 2050-2067
Paragraph
Nordberg Grinders - Flexible Shaft

Operations of Brownhoist Ballast Cleaning Machines

Painting of Machinery

Operation of Brownhoist Ballast Cleaning Machines

Operators - Qualification and Examination

Orange Peel Buckets

Pile Drivers

Plows, Snow - Russell-Type

Plows, Snow, Detachable - Autotrack

Plugs, Spark

Pneumatic Tamping Machines

Pneumatic Tools

Portable Stock Rail Grinders - P-16

Power Wrenches

Pullers, Spike - Hydraulic (Fairmont)

Pullers, Spike - Mechanical (Nordberg)

Pullman Power Ballasters

Pumps, Portable

P-11 and P-11-S Joint Cross Grinders

Rail Drills - Power

Rail Grinder Cars

Rail-Highway Vehicles

Rail Lifters

Rail Milling Machines - Power

Rail-Oiling Car

Rail Saws - Power (Racine)

Repairs and Adjustments to Machinery

Russell-Type Snowplows

Safety of Operation

Saws, Rail - Power (Racine)

Saws, Timber

Scarifiers - Drainage Car and Ballast Shaper

Scarifiers, Tie-bed

Shafts, Flexible, and Attachments

Shifters, Track - Power (Nordberg)

Shipping of Machines

Signals, Hand - For Hoisting Equipment

Snowplows, Detachable - Autotrack

Snowplows, Russell-Type

Snow Sweepers

Spark Plugs

Spike Master, R. M. C.

Spike Pullers, Hydraulic - Fairmont

Spike Pullers, Mechanical - Nordberg

Spreader Cars - Jordan

Starting Free-running Engine

Steam Boilers

Steam Hammers

Stock and Switch Rail Grinders

Storage Batteries

Storage of Machines

Supervision of Machinery

Switchers, Track

Tampers, Multiple

Tie-bed Scarifiers

Tie Borers

Tie Handlers - Nordberg Gandy

Tie Handlers - Railway Track-Work

Paragraph

Nordberg Grinders - Flexible Shaft

Nutters, Power - Raco and Nordberg

Operation of Brownhoist Ballast Cleaning Machines

Operators - Qualification and Examination

Orange Peel Buckets

Painting of Machinery

Safety of Operation

Steam Boilers

Steam Hammers

Stock and Switch Rail Grinders

Storage Batteries

Storage of Machines

Supervision of Machinery

Switchers, Track

Tampers, Multiple

Tie-bed Scarifiers

Tie Borers

Tie Handlers - Nordberg Gandy

Tie Handlers - Railway Track-Work
Tie Inserters - Fairmont
Tie Nipper and Spiker
Tie Removers - Fairmont
Tie Tamper - Multi-tool
Tie Tamper, Pneumatic - Hand
Timber Saw
Tire Pressure
Tools, Pneumatic
Track Cleaners - PM and Athey
Track Gauges
Track Jacks, Power - Nordberg
Track Liners - Nordberg
Track Liners - R.M.C
Track Liners - Railway Track-Work
Track Motor Cars
Track Shifters, Power - Nordberg
Track Sweepers
Tractor Compressors, Crawler
Tractor-mounted Earth Borers
Tractors, Crawler
Tractors, Wheel-mounted
Trenching Machines - Barber-Greene Model 44
Trenching Machines - Barber-Greene Model 702
Trucks, Auto, Automobiles, Trailers
Trucks, Rail-Highway

Weed Burners
Weed Mowers, Off-track
Weed Mowers, On-track - Fairmont
Weed Spray Cars
Welding Generators
Wire Cables - Installation and Care of
Wrenches, Air Impact
Wrenches, Power - General
Wrenches, Power - Nordberg Model CW
Wrenches, Power - Nordberg Model DW
Wrenches, Power - Raco Model A
Wrenches, Power - Raco Model C

Paragraph

6040-6048
6050-6056
6030-6038
400-459
3030-3048
4050-4074
42
3030-3048
6070-6082
7000-7016
1900-1913
7021-7031
7040-7048
7050-7052
1000-1014
7070-7076
5090
361-366
1400-1410
7100-7127
7150
7300-7302
7310-7326
7200-7206
1050-1068
7400-7415
2050-2067
2070-2073
7450-7457
1550-1556
800-825
8580-8583
8500-8510
8535-8551
8560-8575
8511-8522
8525-8533
GENERAL INSTRUCTIONS

1. This Manual is issued for the guidance of Operators, Foremen, Supervisors, District Engineers, and others concerned in the inspection, operation, performance, and maintenance of Maintenance of Way machinery, including Tools, Roadway Machines, Work and Miscellaneous Equipment used in Maintenance of Way service, and applies to leased as well as to Company-owned machinery.

2. The Chief Engineer, Assistant Chief Engineer-Maintenance, Engineers M.W.&S., and Regional Engineers shall exercise general supervision over all Maintenance of Way machinery in their respective territories. The District Engineer and his staff shall exercise direct supervision of all Maintenance of Way machinery assigned to their custody.

Operator Responsibility

3. Operators and others concerned must be governed by the book of rules, safety rules and all other instructions issued by the Company pertaining to the safe operation of the machines.

4. SAFETY is the first and most important consideration. In all cases of doubt and uncertainty the safe course must be taken. Carelessness as to the safety of one’s self or others is sufficient cause for discipline.

5. All operators of maintenance-of-way equipment shall pass oral or written examination, as shall be required by an authorized examiner, concerning portions of the Book of Rules, Safety Rules, Letters of General Practice, and all other published instructions pertaining to the safe and efficient operation of the machine to be worked by the operator. Record of such examination shall be maintained in the office of the District Engineer on the form M.W. 64, in accordance with the Letter of General Practice No. 258.

Instructions concerning maintenance-of-way machines are included in:

(a) Form S-7C Rev. - Safety Rules.
(b) Form C.T. 290 - Safety Rules Applicable to Electric Territory.
(c) Form C.E. 81 - Instructions Covering Use of Certain Maintenance of Way Equipment.
(d) Letters of General Practice Nos.:
   (1) 214 - Crane Maintenance Instructions.
   (2) 216 - Welding of Rail and Frogs.
   (3) 219 - Use and care of Abrasive (Grinding) Wheels.
   (4) 222 - Grinding Rail, Frogs and Switches.
   (5) 224 - Maintenance of Track Motor Cars.
   (6) 248 - Operation and care of Autotrucks, Etc.
   (7) 260 - Handling and Care of Oxygen and Acetylene.
(e) Chief Mechanical Officer's Instructions Nos.:
   (1) 65 - Operation of Track Sweepers.
   (2) 106 - Inspection and Care of Steam Boilers.
   (3) 193 - Power Car Maintenance Instructions.
   (4) 206 - Rail Grinding Car Instructions.

6. The “Standard Clearance Gage for M.W. Track Machinery,” Standard Plan 77325-A, must be used to prevent any machine from fouling or obstructing any track. Book of Rules, and “Instructions Covering the Use of Certain M.W. Equipment and General Outline of Duties of Certain M.W. Employees,” C.E. 81, will be strictly observed.

7. Machinery Record Number Plates must be applied and
maintained in accordance with Machinery Record Instructions issued by the Chief Mechanical Officer and Chief Engineer, dated July 1, 1953, and Supplements. It will be the responsibility of the Operator to report all missing or illegible Number Plates.

8. Each operator is responsible for the proper care and safe operation of the equipment in his charge. He must familiarize himself with the parts of his machine, its adjustments, and its lubrication. He should become familiar with all of the general instructions and also those pertaining specifically to the machine in his charge.

9. The operator of a machine must give his undivided attention to its operation. Others on or near the machine must not distract his attention, except as necessary in case of emergency.

10. The operator of a machine should become familiar with the sound made by it when it is operating correctly. Any knocking or other unusual noise must be investigated promptly and the cause found and corrected.

11. All machines must be operated within their rated capacity and must not be overloaded.

12. The equipment must be operated safely at all times and in such a manner that it is protected from damage.

13. Before starting the engine on any unit of equipment at the start of a work shift the operator must:
   (a) Check oil level in engine crankcase and fill to proper level if low.
   (b) Check level of coolant in radiator and fill if necessary.
   (c) Check fuel supply and refill.
   (d) Remove cover from exhaust pipe.
   (e) Perform any lubrication required.
   (f) Remove any covers, housings, or tarpaulins which interfere with the operation of the machine.
   (g) See that brakes are set and all other controls are in proper position.

14. Before starting the engine on any unit of equipment that has been received by shipment or has been out of service for a considerable period of time, the operator must observe the above rule, and in addition must:
   (a) Check level of lubricant in all gear cases.
   (b) Visually inspect all parts of the machine, with particular attention to guards, cables, hose lines, pins and clevises.
   (c) Check condition and adjustment of control levers and pedals.

15. Before operating controls to put machinery in motion the operator shall:
   (a) Make sure that no persons are in a position which could result in personal injuries.
   (b) Inspect the machinery to insure that moving parts are free and that tools, wiping rags, and other material which may be on the machine are clear of moving parts.

16. When operating the controls to put machinery in motion the operator shall:
   (a) Start the machinery in motion slowly, observing the sound and action of moving parts.
   (b) Be prepared to stop the machinery if unusual noise or actions occur.

17. While the equipment is in operation the operator must avoid all obstructions such as line wires, trees, fences, poles, and buildings, as well as cars on adjacent tracks.
18. The operators of on-track equipment must, when moving:
   (a) Be sure that switches are properly lined before moving through them.
   (b) Observe the rails ahead for obstructions.
   (c) Personally inspect the condition of the track in unusual conditions, such as a washout.
   (d) Inspect the condition and placing of set offs and set off devices before moving the machine on or off the set off.

19. Operators of off-track equipment must:
   (a) Inspect the ground over which a move is to be made or work is to be done.
   (b) Operate at such speeds as ground conditions will safely permit.
   (c) Be particularly careful to avoid slipping off embankments or into holes.

20. At the end of each day's work the operator should:
   (a) Inspect his machine and make such repairs or adjustments as are required. If conditions are found that he cannot correct, the proper officer must be notified in detail of the deficiencies found.
   (b) Set the brakes on his machine.
   (c) Leave booms, buckets, blades, and other attachments or accessories suspended from the machine in a safe position.
   (d) Apply and lock housings, covers, doors or other protective devices.
   (e) Cover the open ends of vertical exhaust pipes.
   (f) Take such other actions as seem necessary to protect the equipment against pilferage, vandalism or damage by weather.

21. When it is known that the machine is to be idle for some time, the operator must comply with above and, in addition, must:
   (a) Apply protective grease or oil in parts of the machine which would be adversely affected by corrosion.
   (b) Drain the fuel system.
   (c) Drain the cooling system unless it is fully protected by an anti-freeze solution.

22. General cleanliness of machinery is necessary for proper operation and to avoid personal and fire hazards; also to facilitate the inspection and repairs of the machinery. The operator will be responsible for the general cleanliness of his machine. Gasoline and other high volatile liquids must not be used for cleaning machinery on account of fire hazard. Magnasol or turpentine substitute, Material Catalog Reference No. 47-2488, will be used to clean machines and machine parts. In cleaning machines, clean cotton rags should be used. Waste should not be used for this purpose.

Repairs and Adjustments

23. Repairs and adjustments to equipment must not be attempted except by one familiar with what is to be done and how to do it. If extensive repairs are required, the operator must consult with the Repairman M.W. Equipment or his supervisory officer to determine whether repairs should be made in the field or the machine sent to shop. Those making repairs to equipment shall be governed by the following:
   (a) Repairs and adjustments shall not be made while engine is running or while machinery is in motion, except as outlined in paragraph (b).
   (b) Repairs and adjustments which can be made only with engine running or while machinery is in motion
are permissible; but employees making these adjust­ments shall exercise care and use good judgment to avoid personal injury and damage to property.

(c) Repairs and adjustments to equipment loaded upon flat cars shall not be made while cars are in motion.

(d) Employee making inspection, repairs or adjustments shall provide necessary protection against train movements when equipment is on or near tracks, and against movement of equipment by gravity at any location.

(e) Repairs by welding must not be made without proper authority.

(f) When necessary to dismantle a machine along the right-of-way, particular care should be taken in re-assembling to keep parts free from grit and dirt.

(g) When necessary to make temporary repairs to equip­ment, permanent repairs must be made as soon thereafter as possible.

(h) Unless otherwise specified, all adjustments to engines and machines should be made in accordance with manufacturer's instructions.

24. Manufacturer's identification plates on work equip­ment must be preserved and kept on the equipment. These plates should not be covered with paint.

25. When ordering parts for work equipment, the fol­lowing information shall be given:

(a) Name, make, and model of machine.
(b) Manufacturer's serial number of machine.
(c) Railroad machine number.
(d) Symbol number and description of part, as shown in parts list.
(e) If the parts required are for the engine or for acces­sories such as the generator, magneto, carburetor, etc., give the make and manufacturer's serial num­ber of the engine or accessory, in addition to the symbol number and description of the part.

26. The use of pliers, alligator or pipe wrenches is pro­hibited in places where open-end or socket wrenches should be used, especially on brass or copper fuel line fittings.

27. Open flames should not be used to thaw out radia­tors, carburetors, or fuel lines, etc.

28. Spark plugs when applied in air-cooled motors which are hot should be tightened only by hand and not with a wrench.

29. A torque wrench will be used in tightening head and bearing bolts of engines, compressors, etc., to apply proper torque to each bolt in accordance with manufacturer's in­structions. When this information is not available, a torque wrench must be used to insure equal torque being applied to all bolts of same engine or machine.

30. Air filters must be serviced in accordance with manu­facturer's instructions. In absence of manufacturer's in­structions, they must be serviced in accordance with the following:

(a) All connections must be kept tight.
(b) Oil bath filters will be examined during the begin­ning of each tour of duty and when found dirty will be removed, reservoir cleaned and refilled with medium grade of non-detergent oil, Material Catalog Ref. No. 37-59. Filters will be removed and cleaned at intervals of not more than each 50 hours of service.
(c) Oil bath filters with pre-cleaners must be serviced the same as oil bath filters. Re-oil with medium gas engine oil, Material Catalog Ref. No. 37-59.
(d) Felt of felt-type filters must be cleaned with turpen-
tine substitute, Material Catalog Ref. No. 47-2486, and reinstalled when dry.

(e) Dirty filtering elements of Airmax-type filters must be washed with turpentine substitute, Material Catalog Ref. No. 47-2486, and re-oiled with medium gas engine oil, Material Catalog Ref. No. 37-59.

31. Lubricating oil filters must be serviced in accordance with engine or filter manufacturers' instructions.

32. Following listed hand tools are considered necessary to make the adjustment and minor repairs required to be made by operators of machines:

10" adjustable wrench,
12" adjustable wrench,
10" screwdriver,
1½-lb. hammer,
Gas or common pliers,
1½" combination box and open-end wrench,
1½" combination box and open-end wrench,
¾" combination box and open-end wrench.

Transfer, Shipment and Storing of Machines

33. All M.W. machines and equipment, when not being used, must be stored where they will be protected from the weather, theft of parts, and fire. Each gasoline-powered machine, before being stored, must be given the following treatment:

(a) Drain fuel tank, then run engine several minutes until carburetor has been run dry, the supply from the fuel tank to the carburetor or fuel injectors having first been stopped.

(b) Spark plugs to be removed and cleaned, adding sufficient light gas engine oil, Material Catalog Ref. No. 37-56, through spark plug holes to completely cover the piston heads to a depth of ⅜ inch. Replace spark plugs and turn engine over, either with starter or by hand, with ignition turned off, for at least 10 complete revolutions. At least once each month, while machine is stored, oil should be applied and engine turned over as stated above.

(c) All doors, panels, locks, etc., must be in place and locked or sealed.

34. When machines are to be shipped, stored or are idle for thirty days, the gasoline tank and cooling system of the engine must be thoroughly drained and C.E. 32 tag properly filled out and affixed to the machine under the hood or in such a manner that tag will not be defaced or destroyed.

35. When draining a fuel tank, approved safety container must be used.

36. When removing fuel from a fuel tank, in which outlet is in an inaccessible location, a rubber hose shall be used from such location to a safety container in an accessible location, for gravity flow.

37. Shipments or transfers (i.e., between Supervisors, to and from repair shops, etc.) will be reported by both shipper and receiver using form M.W. 79.

Miscellaneous

38. All Roadway Machines, unless other specific instructions have been issued, will be painted with Yellow Enamel, Quick Drying, Material Catalog Ref. No. 47-2590, and lettered and numbered with Black Enamel, Quick Drying, Material Catalog Ref. No. 47-2218.

Power tools such as Air Tamping Guns, Air Spike Drivers, etc. will be painted Structural Gray, Material Catalog Ref. No. 47-2236.

Work equipment and miscellaneous equipment will be painted in accordance with instructions issued by the Chief Mechanical Officer.
When field repairs are made to machines and equipment, the unpainted portions must be covered with appropriate paint. Spray enamel in pressurized 11-ounce cans is stocked by the M.W. Storekeepers under the following Material Catalog Reference Nos.:

<table>
<thead>
<tr>
<th>Color</th>
<th>Reference No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>47-2574</td>
</tr>
<tr>
<td>Yellow</td>
<td>47-2581</td>
</tr>
<tr>
<td>Structural Gray</td>
<td>47-3118</td>
</tr>
</tbody>
</table>

39. Machines equipped with internal combustion engines (either fuel oil or gasoline) may not be operated in tunnels until after it has been determined it is safe to do so.

40. M.W. machines being operated in or on piers, freight stations, shops, warehouses, etc., must be clean, free from accumulation of oil or grease and dust, free of leaking gasoline or fuel lines; carburetors must not be allowed to "flood", dropping fuel onto oily or wooden floors, and exhaust pipes must not be permitted in proximity of flammable material, such as rags, paper, etc.

41. M.W. machines having fuel tanks of 5-gallon capacity or over must be equipped with a valve, with cap or plug attached, for draining. Those having fuel tanks under 5-gallon capacity must be equipped with a cap or plug for draining.

42. Air pressure in pneumatic tires on M.W. machines and equipment will be maintained at not less than 80 percent of that specified by manufacturer of machine or tires.

43. Autotrucks, earth-moving machines, truck trailers, highway cranes having an over-all height in excess of 10' 0" will have height stenciled in a prominent location in operator's cab.

44. Before mobile cranes, crawler and locomotive type cranes and shovels, pile drivers and similar boom equipped machines are used in proximity to overhead electrification wires, electric power lines or high tension electrical apparatus, the boom and supporting frame must be equipped and properly grounded in accordance with Chief Mechanical Officer plan No. D-448643.

45. Gauges, meters, and other accessories which indicate engine temperature, oil pressures, etc., shall be observed frequently by the operator. When one of these accessories fails to operate or indicates an abnormal condition, determine the cause and correct it, if possible. Bad order accessories of this type should be replaced as soon as possible. A machine should not be operated with a bad order accessory when the condition indicated by it is vital to satisfactory operation, unless it is known that no damage to equipment will result. The governor or safety valve on any unit of equipment must not be tampered with, and shall not be changed, adjusted or reset without proper authority.

46. All M.W. machines, for which specific instructions covering their inspection are not included in this manual, will be inspected by a Repairman-M.W. Equipment at intervals not exceeding six months. Each time a machine is repaired or inspected, the Repairman will prepare form M.W. 15.
INTERNAL COMBUSTION ENGINES - GENERAL

60. The operator should not tamper with carburetor, magneto, primer, lubricating system, fuel injectors and pumps, or distributor, unless he is absolutely positive these need attention and is competent to make the adjustments required.

61. When filling fuel tanks, approved cans must be used. The nozzle of the fuel hose or pipe must touch the tank to prevent sparks from static electricity. Engine must be stopped and gasoline must not be allowed to overflow, as any contact with hot engine parts may cause fire. Smoking, open lights and fires in vicinity are prohibited.

62. When gasoline is to be drawn from metal container, iron or steel pipe must not be inserted in the metal container. Brass pipe, copper pipe, or non-metallic flexible tubing must be used.

63. The three essentials for proper operation are, in order of importance:
   1st - Oil.
   2nd - Water (if not an air-cooled engine).
   3rd - Fuel.

64. Running out of fuel results in short delay. Running out of water or oil results in long expensive delays for re-grinding cylinders, fitting new pistons, rings and other costly work in shops.

65. Before starting engine it is essential to see that lubrication has been provided and that the cooling system is ready to function properly. In the use of two-cycle gas engines, lubricating oil is to be mixed with gasoline; the mixture should be of the proportion of one-half pint of S.A.E. 30 gas engine oil (Material Catalog Ref. No. 37-346) to one gallon of gasoline, except in new engines or engines with re-ground cylinders, in which the quantity of oil should be increased 50% during the first thirty days of operation. In new four-cycle engines, or when cylinders have been re-bored or new rings applied, one-half pint of light gas engine oil or one-half pint of air compressor oil should be mixed with each gallon of gasoline during the first 100 hours of operation, after which no oil need be added to gasoline. Care should be exercised to avoid excessive use of "overhead" lubrication through fuel system on account of affecting combustion. In adding oil to gasoline, oil should be measured rather than depending on the color of the mixture to obtain the proper amount of lubrication. Oil must be mixed thoroughly with gasoline by stirring before placing in the gasoline tank and no attempt made to mix in the gasoline tank.

66. In some of the engines the timing of the spark is automatically controlled, but there are engines in service in which spark timing is manually controlled. When starting an engine of the latter type, the spark must be retarded to avoid injury to the man cranking the engine. After the engine has started, the spark must be advanced as far as possible without causing loss of power or spark knock. Engines have been damaged by operating them when the spark was not advanced far enough. When applying the load the throttle must be opened slowly. Avoid racing the engine. When idling, cut the speed down as low as possible. Unnecessary idling is prohibited. When starting, do not speed the engine - racing induces high bearing pressures and excessive vibration. In cold weather serious damage may be caused by putting the engine to work before lubricating oil has warmed up and has had a chance to distribute properly. Before engaging main clutch, all machinery should be out of gear so far as possible and the load applied gradually. When starting engine by hand, in addition to precautionary measures relative to retardation of spark, starting-crank handle should be grasped with the thumb on the same side of handle with fingers, and the body kept as far away as possible, so that in event of accidental backfire there will be no danger of breaking the wrist or inflicting other injuries.
67. The proper procedure in starting a free-running gas engine when cold is as follows:

(a) With ignition off, close choke and turn motor over several times; then open choke as required.
(b) Retard spark and turn on ignition.
(c) Give crank quarter turn by pulling.
(d) After motor has run a few minutes open choke wide and advance spark.
(e) Do not use choke when engine is hot.
(f) In case of semi-diesel engines, as soon as engine is sufficiently warm, turn on fuel oil and shut off gasoline.

68. When engines are equipped with starting motors and storage batteries, the battery must be inspected by the operator to determine that all cells are filled with liquid to proper level and that the specific gravity of the liquid is correct. If filling is required, distilled water or water which is known to be safe for this service should be used. In cold weather the battery must be kept well charged for two reasons:

(a) The battery will freeze if not well charged.
(b) More power is required to start the engine in cold weather.

The battery charging ammeter must be kept in proper working condition at all times and battery must not be overcharged.

69. In the lubrication of a four-cycle gasoline engine, it is of prime importance to keep a supply of good oil in the crankcase. With a new or rebuilt engine the crankcase should be drained after every 20 hours of operation for the first 100 hours and then after every 50 hours of operation. The best time to drain the crankcase is just after a run when the engine and oil are hot and the sediment is in suspension in the oil. It is essential that the proper amount of oil be maintained in the crankcase; insufficient oil will cause serious damage to engine by burned-out bearings, scored cylinders or frozen pistons. Surplus oil is also detrimental, causing excessive carbon deposits on the cylinders, spark plugs, valves, etc. Carbon causes damage by cutting valves, valve seats, and cylinders. Some of the carbon finds its way into the crankcase, mixes with the lubricating oil, and causes excessive wear on bearings. Oil pressure gauges must be kept in working order at all times and engines must not be operated with oil pressure below minimum set for the particular engines. Low oil pressure is indicative of either insufficient oil, improper working oil pumps, damaged bearings, or excessively diluted or thinned oil. If a surplus of oil is indicated in crankcase, and an unusual consumption of water occurs, inspection for leaks in water jackets should be made. All engines equipped with oil filters should have same cleaned every 500 hours or new filtering element installed where filter is of non-cleanable type. Air cleaners and gasoline filters should be inspected at each oil change and must be kept in good operating condition at all times.

70. The crankcase must not be flushed with kerosene. Kerosene adhering to the interior of the engine tends to dilute the crankcase oil. Engines with crankcases which do not drain thoroughly should be flushed with a small amount of new engine oil before refilling crankcase with new oil. Neutral oil, air compressor oil, or light gas engine oil are suitable for flushing crankcase. Neutral oil is preferred, and must be used for flushing crankcase in engines where detergent oils are used.

71. Care must be exercised to avoid excessive use of choke or too rich mixtures of gasoline, as the surplus gasoline washes the lubrication off the walls of the cylinders and dilutes the crankcase oil, fouls the spark plugs, accelerates carbon formation, and may result in scored cylinders.
72. If the ignition switch does not function in stopping the engine, the choke must not be used for that purpose. The engine may be stopped by removing wire from switch and grounding it on frame or cylinder block, or shut off gasoline supply. Improper functioning of ignition switch should be corrected at once.

73. The cooling system is extremely important. Frequent inspections should be made to be sure that the radiator is full and not leaking. Under no conditions should proprietary radiator "(No-Leak)" solutions or other compounds be introduced into the cooling system for the purpose of plugging leaks. Pump gland should be kept sufficiently tightened to prevent water leakage, but not drawn up hard enough to cause scoring of pump shaft. Never put water in the cooling system when engine is overheated. In the event of a defective cooling system, the operator will consult the Repairman M.W. Equipment as to necessary corrections.

74. Sediment collecting in cooling system may cause engine to overheat. In this case, proceed as follows:

Fill cooling system with mixture of soda ash and water in proportions of one pound soda ash, Material Catalog Reference No. 47-726, to five gallons of water, run engine with the radiator covered or shutters closed until solution is brought to boiling point, then shut down engine and drain; after engine has thoroughly cooled (requiring a period of one or two hours), flush with clean water before refilling. To each four gallons of water used in refilling cooling system, add one ounce of sodium chromate, Material Catalog Ref. No. 47-743, to retard formation of rust and collection of sediment in the cooling system. This procedure must be followed when antifreeze and water are installed in fall of each year and again in the spring when changing from antifreeze solution to water.

Repairman M.W. Equipment and others using sodium chromate will use, if necessary, silicone base protective cream, Material Catalog Ref. No. 47-1433, to avoid skin injury or irritation that might be caused by sodium chromate.

75. In addition to sodium chromate, the water in cooling systems must be kept alkaline; therefore, the water shall be tested every 30 days with red litmus paper, Material Catalog Ref. No. 47-1200. If water in cooling system is alkaline, it will quickly turn the litmus paper blue. If it does not quickly turn the paper blue, lye (Material Catalog Ref. No. 47-736) shall be added to the water until the litmus paper quickly turns a pronounced blue.

76. Damage to engines from freezing usually occurs at the first frost and is largely due to unpreparedness. Therefore, in the fall, care should be exercised. When in doubt as to weather conditions, and antifreeze solution is not available, the radiator and cooling system must be drained. (This also applies to cooling system of air compressor blocks.) In draining cooling systems, all drain valves and plugs should be opened and wire or other small material be run through drain cock to remove any sediment that may have clogged water passage. Where the engines are operated in enclosed cabs, the overflow line from radiator should be carried to outside so as to avoid the possibility of any fumes from the antifreeze mixture accumulating in the cab. The approved antifreeze should be obtained and supplied, mixed in proper proportion with water, to the cooling systems at a sufficiently early date to insure safety.

77. Permanent type antifreeze, Material Catalog Ref. No. 47-696, in proportion of one-half antifreeze and one-half water, must be used in diesel engines, and in water-cooled gasoline engines where engine and operator are in the same cab.
78. Denatured alcohol or methanol-type antifreeze, Material Catalog Ref. No. 47-426, will be used in all other maintenance-of-way equipment in proportions as indicated by following, to prevent freezing at stated temperatures:

<table>
<thead>
<tr>
<th>Outdoor Temperature at</th>
<th>Pints of antifreeze to be mixed with each gallon of water</th>
</tr>
</thead>
<tbody>
<tr>
<td>+20° F.</td>
<td>1 1/2</td>
</tr>
<tr>
<td>+10° F.</td>
<td>2 1/2</td>
</tr>
<tr>
<td>0° F.</td>
<td>3 1/4</td>
</tr>
<tr>
<td>-10° F.</td>
<td>3 1/2</td>
</tr>
<tr>
<td>-20° F.</td>
<td>4</td>
</tr>
<tr>
<td>-30° F.</td>
<td>5</td>
</tr>
</tbody>
</table>

79. Careful inspection should be made to see that leaks are corrected so that there will be no unnecessary waste of material. Any losses due to unforeseen leaks are to be made up with proper mixture, and losses due to evaporation are to be made up with antifreeze solution.

80. Neither kerosene nor calcium chloride may be used as an antifreeze.

81. During cold weather, with engine cooled by radiators, a higher temperature of the cooling mixture will avoid condensation in the crankcase and maintain the normal efficiency of the engine. The higher temperature may be obtained by covering the lower portion of radiator with a thin piece of wood or cardboard.

82. If an engine develops a knock, it is important that the cause be investigated and corrective action taken immediately.

83. Adjustments or repairs to following listed items marked (1) are to be made by Repairman M.W. Equipment; Adjustments or repairs to following listed items marked (2) are to be made by the Operator:

**Engine Hard to Start**

<table>
<thead>
<tr>
<th>Item</th>
<th>Repairman M.W. Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weak battery</td>
<td>Breaker points adjusted</td>
</tr>
<tr>
<td>Defective Magneto</td>
<td>Breaker points renewed</td>
</tr>
<tr>
<td>Worn brushes</td>
<td>Breaker arm or brushes</td>
</tr>
<tr>
<td>Coils broken or soaked</td>
<td>Loose or defective wiring</td>
</tr>
<tr>
<td>Magneto weak</td>
<td>Spark plugs fouled</td>
</tr>
<tr>
<td>Throttle or governor</td>
<td>Improper gas mixture</td>
</tr>
<tr>
<td>valves loose on shaft</td>
<td>Valve seats bad</td>
</tr>
<tr>
<td>Spark plugs cracked</td>
<td>Water in fuel supply</td>
</tr>
<tr>
<td>Improper timing</td>
<td>Defective impulse coupling</td>
</tr>
<tr>
<td>Fuel flow obstructed</td>
<td>Flow of fuel obstructed</td>
</tr>
<tr>
<td>Valve tappets adjust-</td>
<td></td>
</tr>
<tr>
<td>ment</td>
<td></td>
</tr>
<tr>
<td>Magneto, oil or water</td>
<td></td>
</tr>
<tr>
<td>soaked</td>
<td></td>
</tr>
</tbody>
</table>

**Engine Not Firing Properly**

<table>
<thead>
<tr>
<th>Item</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spark plugs fouled or</td>
<td>Valve tappets improperly adjusted</td>
</tr>
<tr>
<td>improperly adjusted</td>
<td></td>
</tr>
<tr>
<td>Spark plugs cracked</td>
<td>Priming cups leaking</td>
</tr>
<tr>
<td>Valves warped or</td>
<td>Cylinder head gasket leaking</td>
</tr>
<tr>
<td>broken</td>
<td></td>
</tr>
<tr>
<td>Valves or tappets</td>
<td>Manifold gaskets leaking</td>
</tr>
<tr>
<td>stuck</td>
<td></td>
</tr>
</tbody>
</table>

**Engine Overheating**

<table>
<thead>
<tr>
<th>Item</th>
<th>Repairman M.W. Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of oil</td>
<td>Fan belt slipping</td>
</tr>
<tr>
<td>Oil badly diluted</td>
<td>Improper gas mixture</td>
</tr>
<tr>
<td>Lack of water</td>
<td>Improper timing</td>
</tr>
<tr>
<td>Radiator clogged</td>
<td>Spark retarded too far</td>
</tr>
<tr>
<td>Water hose obstructed</td>
<td>Hole or crack in top of</td>
</tr>
<tr>
<td>Water pump defective</td>
<td>piston</td>
</tr>
<tr>
<td>Lubrication obstructed</td>
<td>Engine overloaded</td>
</tr>
<tr>
<td>Carburetor choke valves</td>
<td>Injectors out of adjust-</td>
</tr>
<tr>
<td>partially closed</td>
<td>ment</td>
</tr>
<tr>
<td>Injection pump impro-</td>
<td>Clogged oil filter</td>
</tr>
<tr>
<td>perly timed</td>
<td>Thermostat defective</td>
</tr>
<tr>
<td>Valves leaking</td>
<td></td>
</tr>
</tbody>
</table>
Engine Lacks Power

- Valves holding open or broken (1)
- Valve seats worn (1)
- Piston rings broken (1)
- Piston rings stuck (1)
- Improper gas mixture (1)
- Scored cylinders (1)
- Injection pump improperly timed (1)
- Improper timing (1)

Engine Knocks

- Carbon in cylinders (1)
- Loose main crankshaft bearings (1)
- Loose rod bearings (1)
- Loose piston pin (1)
- Worn pistons and cylinders (1)
- Injection pump improperly timed (1)

Faulty Carburetion

- Carburetor improperly adjusted (1)
- Valves leaking (1)
- Intake manifold leaking (2)
- Gaskets leaking (2)

Excessive Smoke from Exhaust

- Too much oil in crankcase (2)
- Lubricating oil thin - not sealing pistons (2)
- Defective piston rings (1)
- Excessive cylinder wear (1)
- Not sufficient compression (1)

Explosion in Muffler

- Ignition too late (1)
- Weak spark (1)
- Insufficient exhaust valve clearance (1)

Explosion in Carburetor or Intake Manifold

- Gas mixture too lean (1)
- Intake tappets sticking (1)
- Hole or crack in top of piston (1)
- Cracked cylinder head or block (1)

Poor Compression

- Valves not seating (1)
- Valves sticking (1)
- Valve tappets sticking (1)
- Valve tappets set too close (1)
- Piston rings weak (1)
- Piston rings broken (1)
- Piston rings stuck (1)
- Loose spark plugs (2)

84. Fuel tanks must be inspected frequently to insure against leaks. The use of compressed air for locating leaks is prohibited. When a leak occurs, tank must be emptied, then filled with water or steam and thoroughly cleaned, after which, with tank empty, fumes diffused and closing cap removed, repairs can be made in the field by soldering or welding. After soldering or welding, any water remaining in tank should be thoroughly flushed out with gasoline to remove.
water and scale. A flame must never be applied to a tank containing gasoline or oil.

85. Magnetos requiring oil must be carefully oiled (See Section 8800 - Lubrication of Maintenance of Way Machinery and Work Equipment); usually not more than one or two drops a week.

86. Engines must not be operated in closed buildings, such as tool houses, where carbon monoxide gas may accumulate, as this gas is fatal.

87. Two-cycle gasoline engines are lubricated by mixing the lubricating oil with the gasoline. This mixture is often called "mixed gas". Fuel tanks serving these engines are marked accordingly.
INTERNAL COMBUSTION GASOLINE MOTORS
GENERAL ENGINE TUNE-UP AND TROUBLE SHOOTING

100. Satisfactory performance of present-day internal combustion motors requires the use of testing equipment to restore the engine to the original condition in which it operated when new.

101. Any testing or engine tune-up should give consideration to manufacturer's specifications as to proper settings or adjustments.

102. Engine tune-up comprises the following fundamental divisions:

- Compression
- Ignition
- Carburetion
- Lubrication
- Cooling System

103. Since compression does not depend on ignition or carburetion, it should always be checked first.

Compression

104. Before making compression test, engine should be operated at fast idle speed until thoroughly warmed up. Remove all spark plugs; insert a reputable compression gauge in spark plug hole; with throttle wide open turn over engine with starter motor until highest reading of gauge is obtained. (Where engine does not have starter motor equipment it will be necessary to turn motor over by hand.) Repeat the same test on all cylinders. All cylinders should read alike within 5 to 10 pounds.

105. Should gauge show low reading on two adjacent cylinders, a leaky gasket is indicated, but before going further tighten down. Repeat the compression test after tightening to confirm readings.

106. If cylinder shows reading 10 to 20 pounds below normal, squirt liberal quantity of oil on top of piston to assist rings sealing. Care should be taken to see that none of the oil gets on the valves. Repeat the compression test. A low reading in the first test which remains low after application of oil indicates leaky valves; a low reading in first test and a normal reading after application of oil indicates poor cylinder ring fit (possible scored cylinder, piston or poor ring condition).

107. If cause of deficiency is attributed to valve system, the engine will not idle properly.

108. The use of vacuum gauge at intake manifold will be of further assistance in connection with valve condition.

109. Any indication of valve trouble as determined by the vacuum gauge should be supplemented by the use of a compression gauge to determine whether there is a slight leak, or a slow acting valve which will affect the idling of the engine only and not affect running performance, or whether there is a decided loss in compression that will result in poor engine performance or economy.

110. A leak due to cylinder head gasket is noticeable at idle speeds and indicated by vacuum gauge, compression gauge, sound of exhaust, or by its own noise if it is an external leak.

Valve Systems

111. Uniform valve tappet adjustment is essential to uniform and smooth operation of engine.

112. In the absence of specific information, general practice recognizes the following cold settings:

<table>
<thead>
<tr>
<th>Valve Tappet Clearance</th>
<th>L-Head Engines</th>
<th>Overhead Valve Engines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Valves</td>
<td>.010&quot;</td>
<td>.014&quot;</td>
</tr>
<tr>
<td>Exhaust Valves</td>
<td>.012&quot;</td>
<td>.018&quot;</td>
</tr>
</tbody>
</table>
113. When tappets are not to manufacturer's specification clearances, timing of valve opening will be affected, which in turn affects compression pressure.

114. Insufficient clearance will cause valves to burn.

115. Imperfect valve seats and valve faces affect every phase of engine performance and economy.

116. Valve springs, weak or broken, also affect engine performance.

**Ignition**

117. After completing compression tests and correcting any deficiencies evident, the next step is to check electrical system.

**Battery**

118. Starting or ignition (where dependent on battery) is dependent upon battery efficiency.

119. Low or defective battery will cause inaccuracies in tests of starter, generator or ignition systems. See that battery terminals are clean and free from corrosion.

120. Warm water poured on corroded terminals will dissolve the copper sulphate deposit so it can readily be brushed off.

121. The terminals and battery posts should be wiped clean with cloth saturated with household ammonia, taking care that none of the ammonia gets into the battery as it will neutralize the acid solution. After terminals have been thoroughly cleaned they should be given heavy coating of vaseline or cup grease to retard further corrosion.

**Battery Electrolyte Tests**

122. Hydrometer readings should be taken of electrolyte. Fully charged battery should register specific gravity reading at hydrometer of 1.270 - 1.290.

123. A reading of 1.150 or below indicates battery is entirely discharged. Such batteries will readily freeze.

124. Correct level of battery solution should be maintained by keeping plates covered at all times. Use only water which is known to be safe for this service. Distilled water is preferred.

**Starter Motor Circuit**

125. To determine condition of starter motor circuit the use of voltmeter of suitable range is required. Connect voltmeter to ground and to battery side of starter switch, using proper care to see that plus terminal of voltmeter is at plus side of circuit.

126. Crank the engine with starter motor. Starter motor operating at good rate voltage from switch to ground should be between 4.5 - 5.0 volts for 6-8 volt service, or multiple thereof for higher voltage service.

127. Battery in normal charged condition should be capable of cranking engine for period of 15 seconds without appreciable voltage drop because of drain on battery. If the battery meets the demands of this test it is in good condition.

128. Test for battery ground wire connection should be made, using voltmeter reading from ground to battery. Good ground wire connection should show Zero or very slight voltage drop when discharging battery by use of starter motor. Should voltmeter show a reading, it indicates poor ground wire or strap connection, requiring cleaning or renewal.

**Starter Motor Cable**

129. By use of voltmeter readings across the ends of starter cable - battery post connection to switch, condition of cable or terminal can be determined as under Battery.
Ground Wire

130. Where two-wire circuit is used, similar tests can be made to check for undue resistance in either wire, or in switch units.

Ignition - Battery Type

131. The primary ignition circuit consists of lead wire from battery to starter switch, to ammeter, to ignition switch, to coil, to distributing points, with condenser and connections between these units.

132. Loose primary circuit connections cause high resistances, possible open connection, hard starting and poor engine performance.

133. It is, therefore, important that primary ignition circuit be checked for tightness.

Ignition Points (Battery Type)

134. Examine points for burns, pits, dirt - see that they are not sticking on pivot. Check to see that they have proper gap. Breaker spring tension which is too weak or too strong will affect speed performance by floating (weak spring) or bouncing (strong spring).

135. Burned or pitted points prevent accurate setting of gap, and should be dressed or replaced.

136. Use no oil on points, as same carbonizes and causes point burning. In the absence of specific information, general practice recognizes the following:

<table>
<thead>
<tr>
<th>Ignition Point</th>
<th>4-Cylinder</th>
<th>6-Cylinder</th>
<th>8-Cylinder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Breaker Gap</td>
<td>.024&quot;</td>
<td>.020&quot;</td>
<td>.018&quot;</td>
</tr>
<tr>
<td>Dual Breaker Gap</td>
<td>—</td>
<td>—</td>
<td>.020&quot;</td>
</tr>
</tbody>
</table>

Condenser

137. Testing requires special equipment, and the following will apply where such equipment is available:

(a) Defective condenser prevents proper ignition and disables the engine.

(b) Condenser should be subject to breakdown, leakage, capacity and resistance tests.

(c) A condenser which cannot stand the breakdown test will have practically Zero resistance and will serve to "short out" the ignition points.

Secondary Ignition

138. Secondary ignition circuit embraces the coil, spark plug wires, rotor, distributor cap and spark plugs.

Spark Plugs

139. Spark plugs may be dirty, improperly gapped, damaged gaskets, burned electrodes, or cracked insulators.

140. See that plugs are correct type for the engine.

141. The heat range required may vary according to engine loading and performance. It is well, however, to be guided initially by plug manufacturer's recommendation for the type of engine.

142. Spark plug manufacturers provide for heat ranges to suit operating conditions.

143. A cold plug has shorter insulator distance from tip to insulator gasket in body, transmits its heat more rapidly and therefore remains colder at the tip.

144. A hot plug has longer insulator distance from tip to insulator gasket in the body, transmits its heat less rapidly and therefore remains hotter at the tip.

145. A plug which is too hot for an engine will develop small blisters on the insulator, due to the extreme heat under heavy loads and speeds. Under these conditions the tip of the
insulator becomes very hot, causing the gas to fire prematurely before spark occurs.

146. A plug which is too cold for an engine accumulates carbon and oil on its insulator and will eventually develop short circuit which cuts out the spark.

147. A spark plug which is correct for an engine will show fairly clean insulator of slightly brown or tan color. An insulator in this condition but showing accumulation of carbon on the spark plug still indicates that oil is passing at piston rings or valves.

148. Spark plugs set too wide result in poor top speed and will cause hard starting. Gaps too close result in poor idling and low speed performance. In the absence of specific information, general practice is to adjust spark gap to .025".

149. Spark plug gaskets should be in good condition; a dead gasket (compressed solid) will leak in service.

150. Do not cinch the plugs too tight when installing; it will distort the gap and affect the firing. Use oil or grease on plug threads when installing.

Ignition Timing

151. The use of neon timing light with ignition marks on flywheel, or piston travel gauge, should be used to check or set timing.

152. A retard of as much as six (6) degrees will definitely affect maximum performance.

Centrifugal Spark Advance

153. Where used, examine for possible sticking at governor weights or weak springs. Sticking governor weights result in poor pickup. Weak governor springs result in too rapid spark advance - engine ping.

Timing of the Magneto

154. The breaker points should be clean and square, and should be adjusted to .018" (practice ranges from .012" to .022", depending on magneto type).

155. Breaker gap should be checked and adjusted to conform to manufacturer's recommended setting. Points should have square contact without burns or pits - use no oil or grease on the points.

156. Adjustment of Magneto Distributor Gear with relation to magneto armature or cam should not be attempted in the field, nor should any major dismantling of the magneto be done by other than recognized magneto service.

157. At full magneto advance, maximum drag of magneto armature should occur at instant of breaker opening. In retard position (where such is used) the maximum drag will be less pronounced and will occur before breaker points open.

To Set Magneto for Fire Timing

158. Ground the magneto for protection against accidental starting of engine. Bring engine up to firing D. C. for No. 1 cylinder, noting direction of magneto rotation in so doing. Note Top D.C. or T.D.C. marking on flywheel. See that leads to spark plugs are taken off in proper sequence and that No. 1 lead is at No. 1 distributor position.

159. Now bring No. 1 piston to within Ai" of firing top dead center. Measure the Ai" at the stroke and not at the flywheel. Note this position on the flywheel for future reference, as this will correspond to the firing T.D.C. for magneto when engine is running.

160. Turn engine past T.D.C. until the impulse coupling releases (clicks). The magneto has now fired for this position. Back the engine, which will reverse the magneto rotation until breaker arrives at normal firing position (this is
the breaking side of magneto cam lobe); the engine is now in firing position for the magneto for normal running speed.

161. If this position does not correspond to the \( \frac{1}{4} \)" before T.D.C. of piston, the engine is out of time. Next note the magneto position for firing. Release the magneto drive and shift until magneto is in firing position for No. 1 cylinder as above indicated. Retighten coupling on shaft. Engine is now ready to test out the setting.

162. With magneto grounded, turn over engine several times to obtain clean charge in cylinders. Remove magneto ground for actual starting. With engine in good condition, same should start without difficulty or without need for excessive spinning.

163. The impulse coupling will click at excessively low engine speeds. Never let engine operate at such low speeds on account of damage sustained by the impulse coupling and its ultimate failure by this abuse.

164. With the engine running: Under loads the engine should operate smoothly without laboring, heating or pingng.

165. Heating indicates late firing and magneto setting should be advanced only sufficient to correct.

166. Pinging indicates too fast ignition timing and will generally show up by engine failing to carry load. Correct by retarding the magneto setting only sufficient to eliminate.

167. After proper magneto time setting has been arrived at, see that magneto couplings are properly secured.

168. For complete detailed information, see magneto manufacturer's service manual.

**Impulse Coupling Lag Angle**

169. Unless otherwise designated by magneto equipment manufacturer, general practice recognizes the following as desirable lag angles (angle measured at crankshaft): Variations from this table are dependent on cylinder size and engine r.p.m.:

<table>
<thead>
<tr>
<th>No. Cylinders</th>
<th>Lag Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15-20 degrees</td>
</tr>
<tr>
<td>2</td>
<td>15-20 degrees</td>
</tr>
<tr>
<td>4</td>
<td>20-25 degrees</td>
</tr>
<tr>
<td>6</td>
<td>25-30 degrees</td>
</tr>
<tr>
<td>8</td>
<td>30-35 degrees</td>
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</table>

**Carburetion**

170. Carburetion is to some extent dependent on both compression and ignition; it should always be checked last when tuning engine.

171. Check carburetor flange for looseness at manifold.

172. Check manifold for tightness at engine block; manifold can be checked by use of engine oil applied at joint. Oil drawn in indicates leaks.

**Fuel Vacuum Pump Diaphragm**

173. Leaky diaphragm will result in fuel draining into crankcase, high fuel consumption, and creating a fire hazard.

174. Baggy diaphragm results in poor fuel supply to carburetor and poor load performance.

**Lubrication**

175. It is essential that engine has adequate supply of oil in crankcase at all times. Use only such oils as are authorized for this service.

176. Excessive loss in oil pressure, experienced after engine has warmed up, is indicative of loose bearing fits.
177. Oil smoke at exhaust indicates cylinder and ring condition.

178. Oil and oil-soaked dirt on engine constitutes fire hazard.

Cooling

179. When operating, it is essential that cooling system be kept filled at all times. Low water will result in overheating, cracked blocks, heads, valve seats. Water pumps should be tight without undue friction and galling at pump shaft. When repacking is necessary renew the entire set; otherwise old packing at bottom of gland will become hard and score shaft.

180. Don't use dirty water in cooling system; use only approved water softeners or cleaners.

181. In freezing weather protect the engine from freeze-up and damage by draining water, or use of approved antifreeze mixtures. When draining, see that all drains have been opened and working. Antifreeze mixtures which are still usable and serviceable should not be thrown away at end of winter season but should be stored in suitable containers.

182. Antifreeze mixtures must be frequently checked to verify their protect temperatures.
AIR-COOLED GASOLINE ENGINES

Carburetor
200. The correct needle valve setting is from three-quarters to one turn open for normal operation. Idle adjustment screw setting is from one-half to three-quarters turn open. The idling speed can be increased by turning the throttle lever adjusting screw clockwise.

Governor
201. The motor speed can be changed by varying the tension on the governor spring. Increasing the tension by turning the governor adjustment nut to the right or clockwise increases the motor speed. An additional increase in the motor speed can be obtained by moving the long loop end of the governor spring from the lower notch in the governor lever to a notch higher.

Setting of Governor Lever
202. With governor lever loose on governor lever shaft, turn governor lever shaft to the right as far as possible, until it strikes a stop inside the crankcase. With the throttle link hooked on both the carburetor throttle shaft bell crank and end of governor lever, pull governor lever down far enough to bring the carburetor throttle lever against the throttle lever stop on the side of the carburetor. With the lever pulled down to this position and the governor lever shaft against the stop inside the crankcase, tighten the hexagon cap screw to lock governor lever on its shaft.

Tappet Clearances
203. The tappets are provided with cap screws and locking nuts for making the necessary adjustments. The clearance at the intake valve should be in accordance with manufacturer's instructions.

Ignition
204. The magneto points must be clean and lined up squarely so that when they come together they make good electrical contact. The gap between the contact points should be .020". The adjustment of the gap can be made by loosening the contact screw locknut and turning the screw to its desired position. It is also important to keep the spark plug points clean and at a gap of about .020" and to be 18 m.m. size.

205. The operator should have a spare aluminum key on hand at all times to enable him to make field replacement in case flywheel key becomes sheared.
DIESEL ENGINES

250. Types of Diesel Engines are, as follows:
   (1) Straight Diesel
   (2) Semi-Diesel
   (3) Oil Engines

251. Straight Diesel Engines are those in which the cylinders are fired by the compression of the air taken in through intake valves.

252. Semi-Diesel and Oil Engines are those in which the fuel and air are taken in and compressed, and fired by means of an electric spark.

253. Some so-called Straight Diesel engines are started by means of an additional auxiliary gas engine, which operates until sufficient heat is generated for the diesel engine, when the latter automatically starts operation and the gas engine is released and operation discontinued.

254. Another type has an additional set of intake valves in the cylinder head of the diesel engine, which permits the diesel engine proper to be started as a gasoline engine, and after sufficient heat is generated in the cylinders to operate as a straight diesel engine.

255. A diesel engine, when equipped with an auxiliary gas engine as a starter, must be started as per instructions on Gasoline Engines or the manufacturer's instructions.

256. Turn engine with starter or crank until fuel flows freely at filter pump and nozzle. Be sure that all air has been completely removed from the lines, then start the engine. After starting, do not accelerate the engine or operate it at high speed until warm enough for oil to flow freely.

257. Under no conditions use crankcase drainage oil for fuel or lubrication.

258. Diesel engines should not be allowed to idle at a speed of less than 400 r.p.m. for more than 10 minutes at any one time.

259. Supply of fuel in fuel oil tank of diesel engines must not be allowed to be exhausted while engine is being run, because of damage that may result to injector system.

260. Compression gauges should be used on diesel engines only to assist in locating trouble. They should be used in accordance with the following:
   (a) Run engine until it has acquired normal operating temperature.
   (b) Disconnect fuel lines from an injector and remove injector.
   (c) Use one of the two fuel lines removed from the injector on 2-cycle diesel engines as a jumper between the fuel inlet and return manifold connections.
   (d) Attach compression gauge with adaptor to hole from which injector was removed.
   (e) Start and operate engine at approximately 500 r.p.m. idling speed, recording gauge reading.
   (f) Repeat above operation on each cylinder until two gauge readings have been taken for each cylinder.
   (g) Difference in gauge readings for any two cylinders should not exceed 25 lbs. per sq.in. Greater difference will indicate check should be made for leaking or sticking valves, or leaking head gasket.

NOTE: Cylinder pressures should be approximately 400 lbs. per sq.in. at 500 r.p.m.

261. Direction of fuel nozzle spray must be controlled. Fuel spray of a nozzle has sufficient power to penetrate the flesh and destroy the tissues of a man's fingers or hands. Fuel oil thus entering a man's blood stream may result in blood poisoning.
262. Diesel engines should not be operated unless there is an indication they are operating at proper temperatures. Water temperature as shown on heat indicator should be between 160 degrees F. and 185 degrees F.

263. Use only an approved heavy-duty detergent oil in crankcase for proper lubrication. If the manufacturer's instructions as to the specific type of oil to be used are not known, use H.D. 30 oil (Material Catalog Ref. No. 37-384) under normal conditions and at temperatures above freezing; with temperature between 0 and 32 degrees F. use H.D. 20 oil (Material Catalog Ref. No. 37-382); at temperatures below 0 degrees F. use H.D. 10 oil (Material Catalog Ref. No. 37-381).
HYDRAULIC SYSTEMS

270. The operator in charge of a machine upon which a hydraulic system is used must see that:
   (a) The oil supply tank is filled to the proper level at all times with the recommended oil.
   (b) The oil is kept clean at all times.

271. Unless qualified or specifically authorized by proper authority, the operator must not attempt to make repairs in the field to hydraulic pumps, motors, rams, control valves, relief valves, check valves and other parts of a hydraulic system, except for replacement of hose, pipelines and fittings.

272. Before starting engine which operates a hydraulic system, the operator must see that:
   (a) Shut off cocks, valves, etc., are in their proper position.
   (b) See that control valves are in neutral.
   (c) In freezing weather, pump and motor shafts are free to turn.

273. After the engine is started, but before it is brought up to operating speed, the operator must:
   (a) Make sure that the hydraulic pump is getting oil from the reservoir. If the pump should heat up quickly after starting, it must be stopped immediately and cause determined.
   (b) Operate engine at fast idle until hydraulic oil has warmed up enough to allow good circulation, as the pumps and motors are lubricated by the flow of hydraulic oil through them.

274. Hydraulic hoses, pipelines and all other connections must be kept tight and free from leaks.

275. If a leak develops in a suction line, it must be repaired immediately to avoid damage to the pump. THIS IS VERY IMPORTANT.

276. When necessary to replace a hose or pipeline in a hydraulic system the operator or employee in charge must:
   (a) Clean all dirt, paint, scale or other foreign matter away from connections.
   (b) Replace the hose or pipeline with one designed for hydraulic service to withstand the maximum pressure of the hydraulic system.
   (c) Make sure that no dirt or foreign matter is inside the hose or pipeline being installed.
   (d) Except in emergency, do not replace seamless steel tubing and fittings with standard pipe and fittings.
   (e) Copper, brass or other low-pressure pipe must not be used for high-pressure lines.

Hydraulic Pumps and Motors

277. All employees concerned in the operation of hydraulic pumps and motors must be governed by the following:
   (a) Unless authorized by proper authority they must not be taken apart in the field to make adjustment or repairs.
   (b) If necessary to replace a pump or motor, extreme care must be exercised to properly align shafts, in order to avoid undue strain on the bearings and seals.
   (c) Belts must be properly tightened to avoid slipping, and undue strain on bearings and seals.

278. If hydraulic pump does not deliver oil, the following trouble should be looked for:
   (a) Pump running in wrong direction.
   (b) Oil in reservoir low.
   (c) Oil intake pipe or suction filter stopped up.
   (d) Air leak in suction line.
(e) Pump shaft running too slow to prime itself.
(f) Oil too heavy.
(g) Broken pump shaft or rotor.

279. If hydraulic pump does not develop pressure, the following trouble should be looked for:
(a) Pump not delivering oil.
(b) Relief valve not properly set.
(c) Relief valve sticking open.
(d) Leak in hydraulic control system (cylinders or valves).
(e) Vanes stuck in rotor slots.

280. If hydraulic pump makes unusual noises, the following trouble should be looked for:
(a) Partially clogged intake line, intake filter, or restricted intake pipe.
(b) Air leak at pump shaft seal or packing.
(c) Stuck pump vanes.
(d) Relief valve chattering.
(e) Faulty head gasket or pump head fit too close.
(f) Coupling misalignment.
(g) Air bubbles in intake oil.
(h) Tank air vent plugged.
(i) Pump running too fast.

Hydraulic Control Valves

281. Adjustment may be made to the operating levers, if necessary, but adjustments to control valves will only be attempted by authorized and qualified employees.

282. Extreme care must be used if any attempt is made to tighten bolts which hold a bank of operating valves, otherwise it is very easy to bind the operating valve spool.

Overload Release Valves, Pressure Regulating Valves

283. These valves are properly set at the factory or shop and must not be changed, except on machines which require frequent adjustment for proper operation, and the operator is authorized to make the adjustment.

Accumulators

284. Accumulators are charged with commercial nitrogen and, when necessary, must be recharged with commercial nitrogen.

285. Only qualified and authorized employees are permitted to precharge the accumulator.

286. Special equipment is required to precharge an accumulator and, unless it is available, no attempt should be made to precharge it.

287. Special gauges are available and must be used to check the pressure in the accumulator.

288. The hydraulic system must be free from pressure before any attempt is made to service or check the accumulator.

Hydraulic Rams

289. All employees concerned in the operation and maintenance of hydraulic rams shall be governed by the following:
(a) Hydraulic rams shall not be taken apart in the field unless proper authority is secured to do so.
(b) Care must be exercised during the operation, and in the replacement, to prevent damage to the piston rod.
(c) If, for any reason, it is necessary to place a ram in a vice, a holding clamp must be used between the vise jaws and the ram cylinder, to prevent damage to it.
(d) Pipe wrenches must not be used on the body of the ram cylinder within the area of the piston travel.
ADZERS - TIE

300. Operators of these machines will operate them only when:

(a) Wearing goggles and safety (baseball catchers') shin guards, Material Catalog Reference No. 46-1176.
(b) Wearing C.R.P. (Chambersburg Reclamation Plant) type metal foot guards.

<table>
<thead>
<tr>
<th>Guard No.</th>
<th>Fits Shoe Size No.</th>
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<tbody>
<tr>
<td>101</td>
<td>8 and smaller</td>
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<tr>
<td>102</td>
<td>9</td>
</tr>
<tr>
<td>103</td>
<td>10 and larger</td>
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</table>

(c) Wearing respirators where unusually dusty conditions are encountered.
(d) Ignition switch is within easy reach.

301. Towing adzing machines at speeds greater than 5 m.p.h. is prohibited.

302. All dirt, spikes, stones or other loose materials which might be struck by cutting bits must be swept from top of ties before they are adzed.

303. Due to adzers being subjected to an unusual amount of dust, the oil, Material Catalog Reference No. 37-56, used in engine air cleaners must be renewed at the start of each day's operation and entire air cleaner thoroughly cleaned after each one hundred hours of operation. Oil must be maintained at level indicated by recessed groove in the oil reservoir.

304. Engine governors should be set to hold the cutter head speed to approximately 1800 r.p.m. and never above 1850 r.p.m.

305. Cutting heads should be kept in balance. When they vibrate excessively, they must be removed from service and balanced.

306. Cutting heads must be adjusted to:

(a) Adze all ties to the proper plane, especially when adzing is done from rails of various heights.
(b) Follow in same path when several machines are used.
(c) Leave same margin of adzed surface on each end of tie plates after plates are put into place.

307. Cutting bits must be firmly secured in cutting head and so placed that cutting edge of bit will not be more than five-eighths of an inch from face of cutting head.

308. Cutting bits that have become so short, by repeated sharpenings, that they cannot be placed in cutting position with more than three-fourths of the cutting head clamp holding the bit, should be discarded.

309. Use of frayed or spliced belts on adzing machines is prohibited.

310. Belt tension should be adjusted by forward or backward movement of engine on the frame.

311. Belt guards must be kept in place and in good condition.

312. Guide pulley must be raised or lowered so that belt runs evenly between the flanges.

313. Guide pulley must be adjusted by moving motor forward or backward, to prevent belt from climbing flanges of the spindle pulley.

314. Guide rollers should be:

(a) Raised only after engine and cutting head have stopped.
(b) Raised before adzer is run over grade crossings, switches, guard rails, etc.
(c) Clear of joint bars when cutting heads are changed.
ADZERS - TIE
(Equipped with Double Flanged Wheels to Avoid Damage to Rail-Head Bonds)

315. With cutting head resting on top of the tie, adjust frame to have double-flanged wheels in vertical position with wheel tread bearing on each top edge of rail head.

316. With counter of wheel tread over center line of rail head, place guide roller against gauge side of rail to hold wheels in this position.

317. IMPORTANT TO PREVENT DERAILMENT—OUTSIDE GUIDE ROLLER MUST BE PLACED ONE INCH BELOW TOP OF RAIL HEAD AND ONE-QUARTER INCH BEYOND OUTSIDE FACE OF SMALLER FLANGE OF DOUBLE-FLANGED WHEELS.

318. When passing over frogs, switches, grade crossings, etc., double-flanged wheels should be slightly tilted from vertical position to raise smaller flange to level of top of rail head.
AIR COMPRESSORS

350. All portable air compressors, excepting those used in paint spraying, will, with all tools working, be adjusted to maintain an air pressure of at least 80 pounds, with regulator set for machine to "load" at 80 pounds' pressure and unload at 90 pounds' pressure.

351. Pressure gauges must not be used unless they are stamped, indicating that they have been tested and inspected at a certain shop within the last twelve months.

352. As soon as a compressor has acquired its normal operating temperature at the start of each tour of duty, the safety valve must be tested to determine that it will operate at a pressure not in excess of 125 pounds. When the safety valve will not operate at a pressure of 125 pounds or less, the compressor may not be operated.

353. All air reservoirs must have dates plainly marked showing when they were originally put in service and given last hydrostatic test. They must be tested five (5) years after first being put into service and once each year thereafter.

354. At close of each day's work, water must be blown out, air pressure blown off and reservoir drain valve left open.

355. A daily test should be made to determine leaky valves in compressor by pumping air pressure of storage reservoir to point where safety valve pops, then stopping machine. If a loss of more than 5 pounds per minute exists, second test should be made, and if loss continues to be in excess of 5 pounds per minute machine must not be operated until proper repairs are made.

356. When compressor intake valves are operated by a camshaft, the care and adjustments are to be the same as that given the engine valves.

357. In piston-type compressors, where compressor and engine lubricating oils are carried in the same crankcase, the oil should be changed or renewed at intervals of not greater than 100 hours.

358. Lubricating oil of rotary-type compressors should be changed or renewed at intervals of not greater than 500 hours.

359. Rotary-type compressors should be operated at a speed of 1800 r.p.m., and reservoir air pressures should not be less than 60 p.s.i. If necessary, reservoir outlet or service valve should be closed sufficiently so that at least 60 pounds' pressure can be maintained.

360. Immediately after starting rotary-type compressors, the air reservoir outlet or service valve must be closed to furnish positive lubrication of the main pump.

Crawler-type Air Compressors:

361. This crawler mounting has an independent reversible air motor drive on each track, one on each side of the machine.

362. Steering is accomplished by cutting off the power supply on the side toward which the machine is to be turned, or if a very sharp turn is necessary, the power can be used, forward motion on one track and backward or reverse motion on the other track.

363. There are no friction type brakes on this machine, all braking being secured through the air-driven motors.

364. Water must be drained from the crankcase of each driving motor each day and the oil level checked. In wet or foggy weather this should be done twice each day, as the water comes from the moisture in the compressed air supplied to the driving motors.
365. Never operate the machine more than 20 minutes when more than fifteen degrees from level position.

366. This equipment has full force feed lubrication and can be operated on a side tilt of 20 degrees and an end incline of 45 degrees.
TESTING AND REPAIR OF PORTABLE AIR COMPRESSORS

370. All compressors will be stenciled at the repair point to indicate name of shop that made repairs, operating pressure, free air capacity in cubic feet per minute at 90 lbs. pressure, and revolutions per minute of engine, not to exceed manufacturer’s recommended speed. This stenciling shall appear on the main reservoir.

371. All portable air compressors in operative condition should be given test at shop to demonstrate their operation and capacity before being dismantled for repairs or turned out for service.

372. Preparatory to such test, compressors should be checked to see that the cooling system is filled with water, and the proper amount and grade of lubricating oil is in both engine and compressor units. Fuel should be in fuel tank to give demonstration test.

373. Ignition and fuel system should be gone over to see that they are in proper condition.

374. After it has been ascertained that unit is ready to run, a demonstration run shall be made to show actual condition of equipment as to water leaks, valve leaks, ignition and governing. Runs should be of sufficient duration to bring machine to normal operating temperature.

375. During demonstration run, check the r.p.m. of engine, pressure obtained in compressor reservoir, and the amount of free air discharged. Multiple orifice test shall be made to determine free air capacity, using “M.W. Air Compressor Capacity Testing Device” per M.E. Department drawing E-432448, as shown on following page.

376. All orifice tests of compressors shall be made on basis of operating pressure as stenciled. Compressors used in tie-tamping service shall be tested at 90 lbs. per square inch.

377. Air compressors which fail to sustain 95% of rated capacity as measured by pressure sustained against prescribed number and size of orifices shall be considered as requiring major repairs.

378. Compressors which have received major repairs involving cylinders, rings, valves, etc., must pass final orifice test based on 100% of rated capacity.

379. When making preliminary test of compressors, check for uniformity of compression at internal combustion motor.

380. Cooling systems shall be subjected to leak test of 5 lbs. per square inch. Use hand air pump or water head 10 ft. above filler neck.

381. Crankcase must be thoroughly cleaned out.

382. All engine parts must be thoroughly examined for defects, cracks, holes, etc.

383. Water thermostat must be checked for opening in range 160° to 180° F. Defective units to be replaced.

384. Magneto's and distributors must be thoroughly checked, overhauled and bench-tested before re-installing.

385. Carburetors to be thoroughly cleaned out. All parts must be “blown out” and worn or defective parts renewed.

386. Recondition all valves where necessary.

387. Where required, renew rings, bore cylinders, apply new pistons.

388. All air reservoirs must be given test as outlined in M.E. Department drawing E-403476 covering non-fired pressure vessels. Main reservoirs shall be painted and paint-stenciled after passing hydrostatic test.
389. Lubricating oil filters must be applied to all compressor engines.

390. Air intake filters shall be applied to both engine and compressor.
PULLMAN POWER BALLASTER

400. This machine must be operated with tamping shoes ahead.

401. Before starting the engine:
   (a) The operator must make a daily inspection of the crosshead locking mechanism and keep it in good operating condition.
   (b) Check should be made to see that the correct shoe assembly is mounted.
   (c) Before releasing the crosshead lock, the operator must inspect the tamping bar assembly to be sure that all parts of it will clear the rail, angle bars, and bolts.

402. At all times, except when machine is actually tamping, the tamping crosshead must be securely locked at top of stroke by the crosshead latch.

403. Adjustments to the crosshead or other parts near it must not be made unless the crosshead is securely locked by the crosshead latch, or when tamping shoes and crosshead are resting on ground and the engine stopped with gears in neutral position.

404. Machine must not be operated more than two hours without inspection of all bolts and loose ones tightened.

405. Do not drop crosshead when machine is on a set-off.

406. The elevation of tamping head must be maintained in accordance with different weights of rail being tamped.

407. Ample clearance must be provided between engagement of forward and reverse propelling clutches, to prevent overheating.

408. The lifting clutch should be adjusted to prevent slippage while the crosshead is being lifted; otherwise, the clutch linings will be badly worn or burned out.

409. The rate of speed of the machine in tamping should be not less than 35 blows per minute, with transmission in second gear.

Lubrication

410. The machine should be adequately lubricated at regular intervals in accordance with the manufacturer's recommendations.
This machine must be operated with tamping shoes ahead.

The operator and other employees concerned in the operation of this equipment must exercise care in traveling to and from work, and shall make sure that:

(a) Setoff rams are fully retracted.
(b) The hydraulic drive, used while tamping, is disengaged.
(c) Workhead is securely locked in its top position.

At all times, except when tamping or machine is being repaired, the tamping heads must be securely locked at top of stroke with the tamping head locks.

When adjustments are being made to tamping heads they must be locked in raised position, or lowered to the ground and engine stopped with controls in neutral.

The elevation of tamping heads must be maintained in accordance with different weights of rail being tamped.

The following manufacturer’s recommended speeds should be maintained:

(a) Engine-driving generators (approximate) 2080 r.p.m.
(b) Generator (no load) 2260 r.p.m.
(c) Generator (tampers operating in air) 2200-2225 r.p.m.
(d) Electric motors 4500 r.p.m.

The following recommended generator voltage must be maintained to prevent damage to it and the electric motors:

No load, switch off 160-170 V.
Motors operating in air 150-160 V.

When no-load voltage is correct but is low when motors are running in the air, check for slipping of belts, clutch, or a defective motor or electric connection.

When no-load voltage is low, although the generator is operating at recommended speed, recharge the generator in accordance with manufacturer’s recommendations.

The hydraulic system capacity is 50 gallons.

The operator should make daily observation of gauge mounted on main hydraulic pump, and thin or change oil as necessary to maintain intake vacuum at the recommended 2 to 4 inches of mercury.

When vacuum remains constant in excess of 5 in., the oil should be thinned in accordance with current instructions, or a lighter oil should be placed in the system.

When vacuum remains constant in excess of 10 in., reduce engine speed until oil is warmed up. If condition then exists, stop engine and determine cause to prevent damage to the hydraulic pump.

The tamping blades must be installed with long point toward the rail.

The tamping blades must be adjusted so that a distance of 16 to 18 inches is maintained between the tips of opposing blades when in raised position.

Since this machine depends upon vibration to do the tamping, it is very important that all bolts, nuts, etc., be kept tight at all times.

Fill oil reservoir on tamping motors daily, and otherwise lubricate and adjust machine in accordance with manufacturer’s specifications.
PNEUMATIC TAMPING MACHINES

450. Instructions concerning Air Compressors, section 350, and Pneumatic Tools, Section 3030, apply.

451. Elevation of tamping head must be maintained in accordance with different weights of rail being tamped.

452. Except when actually tamping, the tamping crossheads must be securely locked at top of stroke by crosshead latches.

453. Line lubricators to be inspected at intervals of not more than four (4) hours of service and, if necessary, filled with air line lubricating oil, Material Catalog Ref. No. 37-338.

454. Pressure-regulating valves to be adjusted to maintain a constant pressure of 80 to 90 pounds to the tamping guns and 70 to 75 pounds on the down-stroke of the air cylinder.

455. Before starting the diesel engine on this unit, the operator shall first perform the following duties:

(a) Open the relief valve and drain the air from the reservoir.

(b) Check the oil level indicator on the oil separator reservoir to insure there is an ample supply of oil.

(c) A three-position manual control lever is used in starting, warming up, and idling the engine.

(d) This control lever must be released to permit the speed and pressure regulator to govern the engine while the machine is in operation.

456. After starting diesel engine, the operator must close the service and relief valves on the oil separator reservoir immediately to establish full lubricating pressure in the compressor.

457. After the engine has warmed up, the operator shall release the manual control lever and adjust the radiator shutters as necessary to maintain the engine at operating temperature.

458. If the engine should start to run backwards, it may be stopped by:

(a) Pulling out the stop button on the instrument panel.

(b) Covering the exhaust pipe to cut off the air.

459. When stopping engine, to prevent the possibility of the air pressure causing the engine to run backwards, the operator and others concerned in the operation of this machine shall be governed by the following:

(a) Close the service valve and wait for the compressor to unload, which will reduce the engine speed to the minimum.

(b) Let the engine run for a minute or two at this speed.

(c) Pull out the stop button on the control panel to cut off fuel to the injectors.

(d) Open the relief valve and drain the air from the reservoir.
NORDBERG CRIBEX
(Chain-Type Cribber)

500. Before starting engine:
(a) Disengage clutch.
(b) Check digging chain for broken pins, and for cracks
in pin plates, chain bushings, and picks.
(c) Properly adjust digging boom for the height of the
rail upon which work is to be done.
(d) Before lowering the boom into the crib, see that
anti-derail arms are in position, and that digging
chain is in proper adjustment.
(c) Know that the hydraulic valves which regulate the
horizontal and vertical movement of the boom are in
correct adjustment.
(f) See that there are no obstructions, such as rail
anchors, signal wires, etc., in the path of the dig-
ging chain.

501. While digging chain is rotating:
(a) Persons passing or standing near should stay on
opposite side of track from digging chain.
(b) Operator keep clear of digging chain.
(c) Employees assigned to this operation should push
machine from side opposite the direction of move-
ment.
(d) This equipment must not be used where the space
(less than 7½ inches) between the ties will not
permit free entrance of the boom and digging chain.

502. To start cribbing operation:
(a) Lower digging boom into the crib gradually and at
uniform speed.
(b) The inward travel of the transverse carriage must
not be started until the boom has reached the end
of its downward travel.
(c) Move the transverse boom carriage into the crib as
rapidly as is consistent with the ballast conditions
and control the inward travel so that "bouncing" of
the boom will not occur.

503. Towing speed should not exceed 15 m.p.h., and
when towing it:
(a) Remove push-pull device and fasten it securely on
machine.
(b) Raise and lock anti-derail arms.
(c) Lock boom carriage in center position.

504. Push-pull device will not clear road crossings,
switches, frogs, and other things of similar height between
track rails.

505. The digging chain is properly adjusted when it can
be pulled by hand a distance of about 1½ in. from center
of boom.
(a) Make digging chain adjustments when chain is at
approximately the temperature of atmosphere.
(b) If adjustment must be made while chain has been
heated from the friction of digging, loosen it at
close of day's work, and readjust the next day
before use.
(c) The drive chain which propels the digging chain
usually requires adjustment when digging chain
adjustment is made.

506. When the ends of the flights on the digging chains
have worn enough to remove the hard surfacing material,
they can be repaired by welding.
507. At least once each day of use, run digging chain slowly through lubricating oil thinned with kerosene or similar diluent.

508. Lubricate driving chains, bearings, and other parts regularly in accordance with the manufacturer's instructions.
510. The operator of this machine must remain upon the operating platform at the controls at all times while the machine is engaged in digging.

511. The operator must be on the alert at all times for long ties and other obstructions which, if struck by the digging buckets, might result in damage to the equipment.

512. The operator shall make inspection and test of the overload release on the bucket drive shaft every 30 days.

513. When digging near insulated joints or at other locations where signal or telegraph wire, cable, pipe, etc. are installed, unless otherwise instructed, the operator shall raise the boom so that no material below the bottom of the tie will be disturbed.

514. This machine should not be towed until the following has been done.
   (a) The boom has been raised to its highest position and securely locked.
   (b) The transverse carriage has been moved to the position where it may be properly locked to prevent movement.
   (c) The propelling chain box has been removed from the operator's platform.
   (d) The conveyor belts are in their proper position and securely fastened to prevent movement.
   (e) The operator's platform has been inspected to insure that it is securely fastened; if not, it must be removed.

515. The standard drawbar designed for and supplied with the machine must be used for towing the machine.

516. The operator must see that the turntable and the hand-operated hydraulic pump furnished with this machine are kept in good condition.

517. All concerned must exercise care when the machine is placed upon the turntable, to insure that the machine is properly balanced.
KERSHAW CRIBBERS
(Wheel-Type Cribber)

520. Before starting the engine:
   (a) Disengage clutch.
   (b) Check to see that digging teeth are not loose. Tighten if necessary.
   (c) Lower digging wheel and position between ties.
   (d) See that all safety guards are properly secured.
   (e) Test machine for proper counterbalance.

521. While digging wheel is rotating:
   (a) Persons should not pass or stand in front of the digging wheel.
   (b) If brush attachment is used, operators should stay on opposite side.
   (c) Operators should keep in the clear of digging wheel.

522. Digging wheel and teeth:
   (a) Teeth that are broken or badly worn should be replaced.
   (b) Keep all bearings well lubricated.
   (c) See that wheel is properly locked and positioned to shaft.

523. To start cribbing operation:
   (a) Start engine.
   (b) Raise digging wheel to proper level.
   (c) Engage clutch and allow wheel to reach its maximum r.p.m.

524. Towing speed should not exceed 10 m.p.h.

525. Drive belt should not be used to start engine.

526. Do not apply belt to drive pulley while engine is running.

527. Keep drive belts in proper adjustment.

528. Laced belts are satisfactory.

529. Install belt as marked to indicate the correct direction of travel.

530. When setting cribber off tracks:
   (a) If removed by manpower, take off counterweights.
   (b) If removing with crane, use proper balance at pickup point.

531. Manufacturer's recommended speeds are:

   Engine __________ 2200 r.p.m.
   Wheel __________ 75-80 r.p.m.
BROWNHOIST BALLAST CLEANING MACHINES

600. Foreman in charge of this machine must, before allowing work to be done, have a clear understanding with the Conductor as to when and how permission will be given by the Conductor to the Foreman to foul an adjoining track, in accordance with Rule 101, Book of Rules.

601. Foreman must also have a clear understanding with the Conductor as to manner in which Foreman will advise the Conductor that fouling or obstruction of an adjoining track has been discontinued.

602. Foreman must not permit machine to be moved from one location to another until buckets or diggers have been secured in clear position, the plow scarifiers, ballast chutes, etc. are raised and secured, the entire organization properly instructed as to the move, and the Conductor advised accordingly that train is ready to be moved.

603. Before making repairs to any moving part of machinery, the part must be stopped and electric current shut off by opening main switch in engine room or disconnecting slip-type connections.

Dirt Car Conveyors

604. When a conveyor requires repairs or is to be coupled into service:
(a) Train must be stopped.
(b) Main switch in engine room must be put in open or shutoff position before uncoupling or coupling of slip-type connections between dirt car conveyors.
(c) When necessary to avoid interference of one conveyor with another, the discharge end of one conveyor should be moved to side of car to clear hopper end of conveyor on adjoining car.
(d) Car carrying conveyor to be repaired should be separated from other cars, provided ballast cleaner can be operated to put dirt into cars between the car carrying conveyor to be repaired and ballast cleaner.

605. Air-brake and air-operating controls referred to in paragraphs 1159 to 1169, inclusive, apply to this machine.
620. All applicable rules and instructions for Track Motor Cars (section 1000) will apply.

621. Before starting engine of this machine the operator must:
   (a) See that hydraulic reservoir is filled to proper level with recommended hydraulic oil.
   (b) Check bolts holding wheels to hubs, to see that they are tight.
   (c) Inspect wire-rope sheaves, to insure that they are free and are getting proper lubrication.
   (d) Inspect all parts of the hoisting mechanism, to assure that it is in good operating condition.

622. The operator is responsible for and must make sure that the hoist lock is applied and that the scarifiers or ballast box support frames are securely chained when:
   (a) Machine is traveling to and from work.
   (b) Machine is traveling light while at work.
   (c) Crossing bridges, passing station platforms and other places where sudden failure of the hoisting mechanism might result in personal injury or damage to property.

623. The operator must see that all employees remain outside the radius of the support frames when they are in the raised position and are not securely chained.

624. When making repairs or adjustments to the support frames or attachments, and it is necessary to be inside the radius of the support frames to do so, the frame shall be lowered to rest and the hoisting wire rope shall be detached from the frame.

625. Care must be exercised while machine is in operation to prevent ballast-leveling boxes from being damaged by contacting ties or other obstructions.

626. All wearing parts must be removed for "Hard Surfacing" before they reach a worn-out condition.
R.M.C. BALLAST DISTRIBUTOR

640. The engine governor should be set for 1800 r.p.m., and hydraulic relief valves set at 1000 p.s.i. These settings must not be changed.

641. Before starting the engine, operator must:
(a) See that hydraulic reservoir is filled to proper level with recommended hydraulic oil.
(b) Disengage clutch and see that all controls are in neutral.

642. Before moving machine, or attempting to work the machine, operate the hydraulic pump slowly for a few minutes to insure adequate circulation of oil.

643. Before traveling or running light with this machine, the ballast conveyors, ballast scoops, and ballast hopper must be placed in tied-down position with all safety chains and locks securely fastened.

644. The operator must inspect this machine before the start of each day's work, to be sure all bolts, nuts, chains, etc. are in safe condition and all hydraulic fittings are secure and tight.

645. All buckets and wear plates must be removed or rebuilt before they are worn to the point where rebuilding is impossible.
650. The Model M23 Series E consists of a heavy motor car with a 6-cylinder, 4-cycle, water-cooled gasoline engine, with automotive type transmission and 7-plate dry disc clutch. A power take-off is provided for operating an air compressor. A separate reverse gear is provided, so that all gear ratios may be used in either direction. A two-stage air-cooled Type 30 Compressor with pressure unloader is used to furnish compressed air to the two rams provided for raising and lowering the various attachments. (125 lbs. reservoir pressure is required.)

651. Box scarifier frames are provided on each side, front half of the car. The scarifier blades are adjustable to all required positions. For ballast leveling and shaping, the scarifier blades are removed and the box frames arranged for mounting steel brushes on them. These brushes are made of scrap steel cable and are for the purpose of brushing ballast off the ends of ties.

652. On the right side rear a universal blader is mounted so that it is adjustable to all positions. It is also provided with an air cylinder so that it may be moved one foot along the axis of the blade while in operation, to compensate for high and low ballast shoulder conditions.

653. This blade is used both for plowing shoulder ballast away from the ties and for plowing it up to the ties and shaping it.

654. On the left side rear of the car a nine cubic foot bottomless scraper bucket is mounted for shaping intertrack ballast and for moving surplus ballast into holes.

655. All the equipment, except the scarifiers, is quickly reversible so that the machine can perform all other work while moving in either direction.

656. All four corners of the machine are provided with suitable adjustable stay chains for regulating the depth of the work.

657. Successful operation of this machine is dependent on the intelligence exercised in adjusting it to the work being done.
BALLAST CLEANING SUPER MOLES

670. Operators and others concerned in the operation shall be governed by the applicable instructions covering crawler-mounted tractors.

671. Operating speeds are as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>1300 r.p.m.</td>
</tr>
<tr>
<td>Travel, Working</td>
<td>0.3 to 0.6 m.p.h.</td>
</tr>
<tr>
<td>&quot; Moving</td>
<td>5 m.p.h.</td>
</tr>
<tr>
<td>Main Conveyor</td>
<td>350 ft. per min.</td>
</tr>
<tr>
<td>Waste</td>
<td>500 ft.</td>
</tr>
</tbody>
</table>

672. This machine should be propelled at slow speed where the digging is very hard, or where a large quantity of ballast is to be handled.

673. Before machine is shut down at close of work, the main conveyor, screen and rear screw conveyor must be free of all ballast and dirt.

674. Wet dirt should not be permitted to harden or freeze about the rear conveyor screw, as it will be impossible to start machine without damage to drive.

675. Mole-digging points must be removed from service and returned to repair shop for rebuilding before distance between actual point and front face of digging point spring bolt lug has decreased to 13 inches.

676. When points are removed and spare points applied, a set of replacement points must be ordered immediately.
BOILERS - STEAM

700. The Operator must be familiar with the steam boiler code in the State in which the boiler is to be used, and be licensed when required. It is his duty to see that the current inspection and boiler-wash certificates are always posted and preserved in legible condition.

701. A steam boiler must not be operated when overdue for inspection or boiler wash, except by authority from the Superintendent-Equipment of the Region on which the machine is working.

702. Use gauge cocks to determine water level. Do not rely on water bottle, as bottles often become clogged. Water bottles should be blown out several times each day.

703. To blow out the water bottle, first close the bottom bottle valve and open bottle drain valve, then close top bottle valve and open bottom valve; next, close drain valve and open both bottle valves. Repeat above operation until clear water appears in bottle. Always open both top and bottom valves wide.

BUCKETS - TIE GRAPPLES - DIPPER STICKS

750. When operating Clamshell, Dragline or Orange Peel Buckets, Tie Grapples or Dipper Sticks, the proper diameter of drum-lagging should be used, as shown on Instruction Sheets furnished by the manufacturers of various types of cranes. Care should be taken to avoid loss of P.R.R. badge plates bearing machinery record numbers. These buckets are subject to rough work and badge plates sometimes become loose and are lost. Crane Operators should keep a record of badge plate numbers on buckets and in case the badge plate is lost should notify their superior, giving correct number of plate.
ATHEY BALLAST RECLAIMER

770. This is a modified Force-Feed HiLoader, specially equipped to pick up ballast from old roadbed, screening the ballast and depositing it in railroad cars or highway trucks.

771. Operators and others concerned shall be governed by the applicable instructions covering Internal Combustion Engines - General, and Hydraulic Systems.

772. The transmission provides for four forward speeds and one reverse, with the choice of two ratios in the rear axle. This allows a selection of eight forward and two reverse speeds.

773. The low rear axle ratio must be used for working, while the high ratio should be used for traveling.

774. The feeder drive shaft is provided with two 3/4-inch heat-treated bolts which will shear if the feeder jams, thus preventing damage to the machine's driving system and shock to the engine. If these bolts shear, the cause must be determined and removed before the bolts are replaced and the machine replaced in operation.

775. All drive chains must be adjusted to be just tight enough to prevent whip and vibration. The idler must be adjusted in accordance with the tightness of the chain.

776. The gear cases must be filled at all times to the check level, as follows:

Temperature below 32° F. - S.A.E. 90 E.P. gear grease,
Acct. 37, Ref. 234.

Temperature above 32° F. - S.A.E. 140 E.P. gear grease,
Acct. 37, Ref. 233.

777. All oil cups must be lubricated daily with S.A.E. 10 oil, Acct. 37, Ref. 87.

778. All grease fittings must be lubricated daily with cup grease, Acct. 37, Ref. 98, or with multi-purpose grease, Acct. 37, Ref. 196.
WIRE ROPE, CHAINS, SOCKETS, HOOKS, SHACKLES, SPREADERS, ETC.

800. Wire rope, chains, sockets, hooks, shackles, spreaders, etc., used with M.W. cranes, crawler tractors, etc. in hoisting work, must be given visual inspection by Engineer of Work Equipment, in charge, at beginning of his tour of duty. Wire rope and electric magnet cable used on M.W. equipment must be as specified in Letter of General Practice No. 328.

801. Hoisting chains and wire rope must be kept free from twists or kinks.

802. (a) Repair of hoisting chains, hooks, spreaders, sockets, etc., at locations other than those specifically designated for that purpose, is prohibited.

(b) Use of so-called "patent links", "repair links", or "figure-eight links" to make repairs to chains, is prohibited.

803. Chain or wire rope used as a pulling bail or loading chain or rope on a dragline bucket is not considered as hoisting chain or rope and may be used until the operator considers it unfit for further service.

804. Following are safe working loads for wrought iron crane chain, Chief Mechanical Officer's Specification 11-I. Chain size is based on diameter of iron of the individual links:

<table>
<thead>
<tr>
<th>Chain Size</th>
<th>Safe Working Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/6&quot;</td>
<td>2,160 lbs.</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>3,840 lbs.</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>8,640 lbs.</td>
</tr>
<tr>
<td>1&quot;</td>
<td>15,360 lbs.</td>
</tr>
</tbody>
</table>

805. Wire rope must be kept properly lubricated with wire rope lubricant, carried at storehouses under Material Catalog Reference No. 37-70.

806. Chains which indicate, on account of wear or stretch, an elongation in excess of 15 percent of their original length, hairline cracks, etc., must be immediately removed from service, carded as defective chain and forwarded to shop designated for receiving defective chains.

807. Hooks, shackles, sockets, etc. that have opened or are sprung must be withdrawn from service immediately and forwarded to shop designated for receiving such defective items.

808. Sockets other than wedge-type may be applied to wire rope only by those specifically qualified to perform the work in accordance with Chief Mechanical Officer's instructions, tracing No. E-438275.

809. The most desirable wire rope for general use is 6-strand (19 wires per strand) preformed plow steel with fibre center. The wires are wound spirally into strands and the strands, in turn, are wound spirally into finished rope. The direction in which they are wound is referred to as the "lay".

810. New wire rope received coiled must be rolled out straight on the ground before being put into service or onto sheaves, to avoid kinks. When uncoiling wire rope, it is important that no kinks are allowed to form, as, once a kink is made, no amount of strain can take it out and the rope is unsafe for work.

811. Wire rope clamps must be of the Crosby type, properly applied. The saddle part of the clamp must always be placed on the load side of the cable and the U-bolts placed on the short end of the cable regardless of the number of clamps used. They must be spaced a distance apart equal to six times the rope diameter.

812. The diameter of a wire rope is that of a circle enclosing it.
813. Except where wedge-type socket is used, the number of wire rope clamps used must be in accordance with the following:

<table>
<thead>
<tr>
<th>Diameter of Wire Rope</th>
<th>Number of Clips - Crosby Type</th>
<th>Length of Space between Each Clip</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>3</td>
<td>21/4&quot;</td>
</tr>
<tr>
<td>5/16&quot;</td>
<td>3</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>7/32&quot;</td>
<td>3</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>9/64&quot;</td>
<td>4</td>
<td>31/4&quot;</td>
</tr>
<tr>
<td>11/32&quot;</td>
<td>5</td>
<td>47/8&quot;</td>
</tr>
<tr>
<td>13/64&quot;</td>
<td>5</td>
<td>53/8&quot;</td>
</tr>
<tr>
<td>3/16&quot;</td>
<td>5</td>
<td>6&quot;</td>
</tr>
</tbody>
</table>

814. Length of dead end of wire rope (meaning the short end), measuring from base of thimble, should be approximately thirty-five times the diameter of the wire rope.

815. All wire rope connections should be made by installing protection thimble in loop to protect wire rope from wear.

816. When using wedge-type sockets with wire ropes:
(a) It is absolutely essential to have the correct size wedge and socket for the wire rope involved.
(b) The loose end shall be wrapped with wire to the main cable, to prevent injury to hands or to prevent catching on clothing, etc.

817. (a) The safe working load of wire rope used for hoisting must be known when it is placed in service.
(b) Safe working load of 6-strand (19 wires per strand) plow steel wire rope is as follows:

<table>
<thead>
<tr>
<th>Diameter of Wire Rope</th>
<th>Safe Working Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>2,200 lbs.</td>
</tr>
<tr>
<td>5/16&quot;</td>
<td>2,920 lbs.</td>
</tr>
<tr>
<td>7/32&quot;</td>
<td>3,760 lbs.</td>
</tr>
<tr>
<td>9/64&quot;</td>
<td>5,760 lbs.</td>
</tr>
<tr>
<td>11/32&quot;</td>
<td>8,240 lbs.</td>
</tr>
<tr>
<td>13/64&quot;</td>
<td>11,200 lbs.</td>
</tr>
<tr>
<td>3/16&quot;</td>
<td>14,600 lbs.</td>
</tr>
</tbody>
</table>

818. Wire rope must run straight and evenly on the sheaves and drums. Overlapping, crossing or chafing against other objects must be avoided.

819. Diameter of sheaves and drums should be not less than:
(1) 30 times the diameter of the wire rope when 6-strand (19 wires per strand) wire rope is used.
(2) 18 times the diameter of the wire rope when 7-strand (37 wires per strand) wire rope is used.

820. One end of a wire-hoisting rope must be securely fastened to a drum or reel, and the rope must never be fully unwound. At least one and one-half full turns remain on the drum or reel. The lifting end must be securely fastened in approved method.

821. Some of the more common causes of failure in wire rope are:
(1) Use of rope of incorrect size, construction or grade.
(2) Allowing ropes to drag over obstacles.
(3) Lack of proper lubrication.
(4) Sheaves and drums of inadequate diameter size that cause short radius bends.
(5) Over-winding or cross-winding on drum.
(6) Sheaves or drums defective and out of alignment.
(7) Rope jumping sheave flanges.
(8) Effects of heat, moisture or acid fumes.
(9) Improper size clamps, thimbles or other fittings.
Improper seizing of rope ends, permitting rope to untwist.
Kinking.
Overloads, reverse bends and other excessive strains.
Grit penetrating strands and wires, causing internal wear.
Excessive fleet angle. (The fleet angle is the horizontal angle between the center line of the sheave and the rope as it winds or unwinds on the drum. This angle should be kept as low as possible.)

Wire rope used for hoisting must be withdrawn from service when the number of broken wires in the length of one lay exceeds number indicated in the following:

<table>
<thead>
<tr>
<th>Diameter of Wire Rope</th>
<th>Permissible Length of Broken Wires</th>
<th>Wire Rope Lay</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>3</td>
<td>2 1/2&quot;</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>3</td>
<td>3&quot;</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>4</td>
<td>3 1/4&quot;</td>
</tr>
<tr>
<td>5/8&quot;</td>
<td>4</td>
<td>4&quot;</td>
</tr>
<tr>
<td>7/8&quot;</td>
<td>5</td>
<td>4 1/2&quot;</td>
</tr>
<tr>
<td>1&quot;</td>
<td>5</td>
<td>5 1/2&quot;</td>
</tr>
</tbody>
</table>

Wire rope used for hoisting must be withdrawn from service when the number of broken wires in the length of one lay exceeds number indicated in the following:

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<th>Diameter of Wire Rope</th>
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<tbody>
<tr>
<td>3/8&quot;</td>
<td>3</td>
<td>2 1/2&quot;</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>3</td>
<td>3&quot;</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>4</td>
<td>3 1/4&quot;</td>
</tr>
<tr>
<td>5/8&quot;</td>
<td>4</td>
<td>4&quot;</td>
</tr>
<tr>
<td>7/8&quot;</td>
<td>5</td>
<td>4 1/2&quot;</td>
</tr>
<tr>
<td>1&quot;</td>
<td>5</td>
<td>5 1/2&quot;</td>
</tr>
</tbody>
</table>

822. Wire rope used for hoisting must be withdrawn from service when the number of broken wires in the length of one lay exceeds number indicated in the following:

823. Chains, wire rope slings, etc., used with cranes for hoisting and removed from service due to defects, must be replaced by wire rope slings per Chief Mechanical Officer's plans:

<table>
<thead>
<tr>
<th>No.</th>
<th>Concerning</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-438997</td>
<td>3/8&quot; wire rope slings</td>
</tr>
<tr>
<td>D-438998</td>
<td>1&quot; &quot; &quot; &quot;</td>
</tr>
<tr>
<td>F-438253</td>
<td>Barrel sling</td>
</tr>
<tr>
<td>F-438254</td>
<td>Choker &quot;</td>
</tr>
</tbody>
</table>

Plan D-438997 - 3/8" Wire Rope:
Capacity - 1 rope, 23 3/4 tons
" " - 2 " 5 "
" " - 4 " 10 "

Plan D-438998 - 1" Wire Rope:
Capacity - 1 rope, 6 tons
" " - 2 " 10 "
" " - 4 " 20 "

On each plan:
Detail No. 1 = 1- and 2-way cable connector
Detail No. 2 = 4-way cable connector, to be used with Detail No. 1
Detail No. 3 = 8' 0" wire rope with open socket on each end
Detail No. 4 = Steel hook:
1 1/4" throat on Plan D-438997
2 1/4" throat on Plan D-438998
Detail No. 5 = Small pin:
1 1/8" x 3 1/4" on Plan D-438997
2" x 4 1/2" on Plan D-438998
Detail No. 6 = Large pin:
1 3/8" x 3 3/4" on Plan D-438997
2 1/2" x 5 1/2" on Plan D-438998
CARS - AIR OPERATED - SIDE DUMP

850. Operators of this equipment must get permission to dump, or foul adjacent track, from Conductor in charge of train.

851. A safety chain should be available for holding trucks to track, if car is loaded in such a manner that it is liable to lift the wheels off rails in discharging the load.

852. When a car fails to right itself after dumping, turn the air pressure back in the dumping cylinder and clear the car of all lading, being sure the door is clear. When all is clear of lading, exhaust the air from the dumping cylinders and car body should return to normal position by gravity.

853. During freezing weather, drain storage reservoir frequently.

854. Exercise care to prevent damage to car body and safety appliances:
(a) By striking with shovel or bucket.
(b) Dropping of heavy materials.

855. Hot materials should not be loaded in dump cars.

856. All moving parts of the body dumping mechanism should be adequately lubricated at regular intervals in accordance with the manufacturer's instructions.

Extension Side Dump

Direction of Dump:

857. The side toward which a car will dump is fixed by the setting of the latch release, dump cylinder and door locks. The latch release is set by turning the locking rod handle.

858. The dump cylinders on each end are carried on the side away from that which the car will dump. To reverse, remove clevis pins, swing cylinder around to other side, and replace pins.

859. The safety hooks should be set to engage the door opposite the dumping side, leaving the door on this side free to open when the body is tilted.

Train Line Connection:

860. The brake line on engine should be connected to supply line on dump cars, and then move Engineman's brake valve to full release position to obtain main reservoir pressure in train supply line. This connection should be broken and brakes re-connected before train is moved from dump. One hundred (100) pounds' pressure in supply line is sufficient to dump the car under any usual conditions of track or loading.

Dumping:

861. To dump a train of cars, move dump valve handle on any car to dump position. To close cars, move same dump valve handle to exhaust position. After cars have closed and locked, return handle to running position.

862. To dump a single car in a train, close the cutout cocks on the operating line on each end of that car and operate the dump valve handle on that car, as described above.

863. To cut out or prevent any car in a train from dumping, close the latch cylinder cutout cock on that car.

864. When dumping under conditions where the load backfills on the doors, cars should be pulled away a sufficient distance to clear before air is released from dump cylinders.
RAIL-OILING CAR

875. Detailed description and operating instructions issued by Chief Engineer, together with necessary blueprints, are posted in the car. On request, the Chief Engineer will furnish additional copies for operators and others requiring these instructions.

876. Nozzles are to be adjusted by operator to spray entire length of longest tie plate found in track, and to spray the rail base and web, including the upper web fillet. Care must be taken not to get oil on running surface of rail, and with the nozzles in good adjustment oil should not strike above the underside of rail head.

877. A fan-shaped spray templet, with stem which may be inserted in the spray nozzle, is used as a guide in setting the nozzles. Upper edge of the upper spray should be directed at the lower edge of the upper web fillet. Outer edge of the lower (vertical) spray should be directed just beyond the edge of the tie plate.

878. Best operating oil temperature is 110 degrees Fahrenheit. At this temperature, and with nozzles in proper condition, the spray will be a solid fan with practically no feathering or spattering. Excessive spattering is evidence of dirty or worn nozzles, or oil temperature too high.

879. A qualified and responsible employe must ride the rear end of the train and constantly observe the track for any evidence of oil getting on head of rail. If oil is observed on head of rail, the train must be stopped, the cause determined and corrected, and the rail sanded where there is oil on running surface.
FLANGERS (Boxcar-Type)

900. The M.W. supervisory officer to whom the car is assigned will arrange through proper channels for any necessary inspection and repairs by the M.E. Department.

901. When a flanger is traveling over the road, even for a short distance, the Flanger Blade Locking Pin must be in place and properly secured by a split cotter key to prevent blade from dropping.

902. Operator must see that proper tools, spare parts and re-railing frogs are provided, be responsible for their safekeeping; and that train signal equipment, where required by law, is in safe and serviceable condition.

903. Operator must be familiar with the physical characteristics of the territory in which he operates flanger and must have a clear understanding with Engineman regarding signals to be exchanged between them to prevent damage to train, switches, platform, highway crossings, dragging equipment detectors, etc.

BALLAST LEVELER (Part of Flanger)

904. Instructions pertaining to operation of Snow Flanger Cars apply.

905. To place Ballast Leveler in position for use:
   (a) Remove safety holding pin which holds operating lever.
   (b) Lower leveler by means of operating lever until it rests on ties.
   (c) Then place safety operating pin under operating lever.
   (d) Adjust extension blade to desired position and clamp securely by tightening clamp bolt nut; pull tight.

906. While traveling and not in use, keep extension blade turned back under car sill.

907. Keep counterbalance heavy enough to raise leveler.

908. Raise leveler as soon as train stops, to avoid damage to leveler in case slack of train runs out or in.

RAIL GRINDER CARS

920. Instructions - Rail Grinder Car Operation and Maintenance, No. 206, issued by Chief Mechanical Officer, will govern.
TRACK MOTOR CARS

1000. Only employees, qualified after examination as to train operating and safety rules governing the operation of track cars on the railroad, are permitted to operate a track car.

1001. Periodic inspections and maintenance of track motor cars will be in accordance with Letter of General Practice No. 224. Record of these inspections will be recorded on metal plate attached to the car. When plate indicates car, to which it is attached, has not been inspected within 90 days, the car may not be operated without specific authority of Regional Engineer.

1002. The Foreman of the gang using a car will assign to each member of the gang a definite place to sit on the car and his part in setting the car on and off the track.

1003. All cars must be inspected daily by the Operator to determine if wheel axles, brakes, engine, transmission, etc. are in safe working condition; also that the car is properly lubricated, sufficient gasoline is in the tank, and no leaks are in the gasoline line. If motor will not start by cranking one-quarter turn, spin motor with ignition off and start spinning with upward motion.

1004. No adjustments are to be made to car in motion, except carburetor of two-cycle engine.

1005. On cars equipped with free running engine, riders must be on car and seated before car is started.

1006. With engine directly connected to axle, making it necessary to push car to start engine, one or two men should be assigned to this work and should do the pushing from the rear and jump on the car from the rear, never from the side.

1007. A motor car should not be run backwards except as necessary in an emergency. Then it should be run very slowly and turned as soon as possible.

1008. When descending grades, the engine should be kept in gear.

1009. Care must be used in running motor cars through interlocking plants, all turnouts and on approach to switches operated by remote control, to avoid accident as result of a conflicting route being set up.

1010. Trailers and push cars must always be pulled, using an approved coupler per M.E. Department drawings F-424396 (16' 0" coupler) or F-423150 (3' 6" or 3' 8" coupler).

1011. Motor, Trailer and Push Cars must not be overloaded.

1012. In maintaining and operating cars, the Foreman or Operator should follow the general rules already given in regard to machines and gas engines in general, paying special attention to the following:

(a) Keep car clean.
(b) Keep car well lubricated.
(c) Do not overload with men, tools or other material.
(d) Do not adjust or tamper with motor unnecessarily.
(e) Devices and attachments that have not been approved must not be applied to motor cars.
(f) The seating arrangement must not be altered.

1013. Standing on car to balance it on a turntable or using the windshield as a lever to balance car is prohibited.

1014. Friction drive discs must be kept clean, and fibre-filled drive wheels must not be allowed to contact friction drive discs when car is not in motion.
RAIL-HIGHWAY VEHICLES

General

1050. Only employees qualified after examination as to train-operating and safety rules are permitted to operate these vehicles. The Operator will be responsible for the safe operation of the vehicle.

1051. Letter of General Practice No. 248, "Automobile Trucks, Rail-Highway Trucks and Highway Truck-Cranes, Etc. - Operation and Maintenance", must be adhered to in the operation and maintenance of these vehicles.

1052. Operation and speed on the rail will be governed as prescribed in S-7C Safety Rules and applicable rules of Book of Rules for track-car operation.

Fairmont A-30 Series A and Series B Hy-Rail Motor Cars

1053. Safe load limit of this vehicle, which has a conventional 4-wheel drive Willys Jeep chassis and non-load bearing rail guide wheels, is 2200 pounds and must not be exceeded.

1054. Tire pressure must be maintained at 70 p.s.i. for rail operation.

1055. The on-track mechanism consists of the following:
(a) Guide wheels and mountings, front and rear.
(b) Hydraulic pump and motor.
(c) Hydraulic rams and control valves.
(d) Hydraulic reservoir.
(e) Piping, relief and check valves.
(f) Steering lock.
(g) Front guide wheel compensator.
(h) 1/4" check gauge.

1056. The hydraulic system must be maintained in good condition, in accordance with the instructions for Hydraulic Systems - paragraphs 270 to 289 inclusive in this manual. It must be kept full with a good grade of hydraulic oil, S.A.E. 20, in temperatures above 35 degrees Fahrenheit, and S.A.E. 10 in temperatures below 35 degrees Fahrenheit.

1057. The following procedure must be followed in preparing the vehicle to operate on track:
(a) Drive vehicle onto track with tires centered on rails; this usually is done at a grade crossing.
(b) Place control valves, which are mounted on dash of vehicle, one at a time in down position to lower guide wheels. Line front wheels straight and engage steering lock. Drive vehicle clear of grade crossing onto a straight level section of track. Now raise the front guide wheels to their upper position and then re-lower them to their down or railing position; then do the same with the rear guide wheels. After this is done, use a 4-ft. pinch bar under the rail guide wheel with a prying action with one hand, while holding the hydraulic piston rod with the other hand to determine that the hydraulic ram piston rod is locked solid in down position. This must be done on each guide wheel every time vehicle is placed on the track or the rail wheels are raised or lowered for any reason while vehicle is on the rail. The four hydraulic rams which raise and lower the rail wheels have a built-in mechanical lock which locks the piston rod when it is in the extended position and rail wheels down. No movement of the piston rod can be felt when the mechanical lock is secure. If, when checking as outlined, any movement of piston rod is noticeable, the lock is not functioning and the trouble must be found and corrected before operating on the rail.
(c) With wheel locked in down or railing position and
all flanges free of the rail, use the 3/4" guide wheel clearance gauge between rail head and wheel tread. The 3/4" gauge should just pass between rail head and wheel tread. If the 3/4" gauge is loose or tight, adjustment must be made on hydraulic cylinder rod. This check must be made without any load in the vehicle. The 3/4" check gauge must be used to check guide wheel setting each time vehicle is placed on the track, and each four hours thereafter until vehicle is removed from the track.

1058. This vehicle has a front guide wheel compensating linkage that automatically maintains the correct clearance between front guide wheels and rail despite variations in load. This linkage must be adjusted under no-load conditions with the guide wheels down, so that the rollers on the rear compensator arm just touch the wear pads on rear suspension arm.

1059. A complete shop inspection of the vehicle must be made by a qualified person after each 2,000 miles of operation, following closely the manufacturer's service and maintenance instructions, paying particular attention to rail wheel gauge, wear, alignment, tram and all other adjustments to the rail equipment.

Fairmont A-30 Series C and A-34 Hy-Rail Motor Cars

1060. (a) Safe load limit of the Fairmont A-30 Series C, which has a conventional Willys Jeep chassis and load-bearing-type rail guide wheels, is 2200 pounds.

(b) Safe load limit of the Fairmont A-34, which is a conventional Pontiac station wagon equipped with load-bearing-type rail guide wheels, is 1250 pounds.

(c) These load limits must not be exceeded.

1061. Tire pressure must be maintained at 40 pounds for rail operation.

1062. The on-track mechanism consists of the following:

(a) Guide wheels and mountings, front and rear.

(b) Hydraulic pump and motor.

(c) Hydraulic rams and control valves.

(d) Hydraulic reservoir.

(e) Piping, relief and check valves.

(f) Steering lock.

1063. The hydraulic system must be maintained in good condition, in accordance with the instructions for Hydraulic Systems - paragraphs 270 to 289 inclusive in this manual. It must be kept full with a good grade of hydraulic oil, S.A.E.20 in temperatures above 35 degrees Fahrenheit, and S.A.E. 10 in temperatures below 35 degrees Fahrenheit.

1064. When used on the rails the load on each guide wheel must be 300 to 350 pounds, and is to be checked with the Fairmont Weighing Jack (which is equipped with a gauge) in the following manner:

(a) Vehicle must be on level tangent track with guide wheels lowered and their flanges clear of the rail head.

(b) Place weighing jack directly under center of guide arm spindle and jack up weight until tread of wheel is just clear of rail.

(c) The reading on the jack gauge now represents the weight in pounds borne by the guide wheel. If this reading is more than 350 pounds or less than 300 pounds, adjustment must be made to bring the weight within those limits.

(d) If much change in the adjustment is made, a re-check for weight on guide wheels should be made.

1065. There are four overload setscrews on the front and four on the rear which must be set at 3/4" between end of setscrew and the stop on the casting.
1066. The following procedure must be followed in preparing the vehicle to operate on track:

(a) Drive vehicle onto track with tires centered on rails.
(b) Place control valves, one at front and two at rear of car, in down position. Remove safety pins, raise handle to release locks.
(c) Operate hydraulic pump to lower wheels onto rail until locks snap into place.
(d) Replace safety pins.
(e) Engage steering lock. When steering lock is properly engaged, a green light burns on the vehicle dash. If light fails to burn, do not attempt to operate until trouble is found and corrected.
(f) Check each rail wheel to be sure it is on the rail properly and flanges are inside the rail.
(g) To remove from the rail, reverse the procedure as outlined above.

1067. Inspection must be made by the operator each time the vehicle is put on rail to determine if it is safe to operate, and when rail operation continues beyond four hours, a second inspection must be made.

1068. A complete shop inspection of the vehicle must be made by a qualified person after each 2,000 miles of operation, following closely the manufacturer's service and maintenance instructions, paying particular attention to rail wheel gauge, wear, alignment, tram and all other adjustments to the rail equipment.
1100. “Crane Maintenance Instructions,” Letter of General Practice No. 214, will apply.

1101. Crane inspections will be recorded on form M.P. 132 or M.W. 84, and copy of form must be posted under glass in cab of crane.

1102. When the posted inspection report indicates crane has not been inspected and approved for use within 30 days, the crane may not be operated without specific authority of Regional Engineer.

1103. When a train is passing on an adjacent track, the crane must be locked with the boom over center line of track on which crane stands. Movement of Model 40 Burro cranes equipped with boom greater than 35 ft. in length must be stopped while trains pass on next adjoining track.

1104. Where no swing limit stops are provided or the work involved necessitates a swing of crane beyond that permitted by the use of limit stops, the adjacent tracks must be protected as provided in Rule 101, Book of Rules.

1105. It is the Operator’s duty to see that no person rides on the crane or on the cars on which crane is mounted except when necessary in the discharge of duty, and then that such persons are required to see that all precautions are taken to prevent injury.

1106. The operator is required to ride on the crane when being moved over the road and it is his duty to see that the center line of crane is kept over center line of car with boom properly anchored; except when crane has been blocked, anchored and prepared for shipment in accordance with A.A.R. Loading Rules and a Car Inspector has attached Form C.T. 310 to car or crane. After such movement, form C.T. 310 must be removed from car or crane before resuming operation.

1107. Multiple part lines must be used for handling heavy loads, and special care taken to avoid kinks in cables. A load should not be lifted more than a few inches before the operator assures himself that the brakes function properly and load can be lowered without dropping.

1108. Cranes mounted on railroad cars must not be worked with boom over side of car until after auxiliary side bearings are in place and the train conductor has been notified that car may not be moved at a speed in excess of 2 miles per hour.

1109. Statement of clearance restrictions of Region on which crane is being operated, together with measurements of crane mounted on car, must be posted under glass in crane cab. Crane operator will, when crane is being used in work-train service, notify train conductor of the restrictions posted.

1110. To prevent possibility of boom being dropped due to slipping of boom hoist brakes, the clutches and brakes should be dried by rotating the machine, slipping clutches and brakes several revolutions before attempting to handle a load.

1111. Never apply rosin, belt dressing or similar compounds to brakes or clutch bands.

1112. Under no circumstances should more than one line be operated from a single drum. Length of lines will be in accordance with Letter of General Practice No. 328 and information posted in crane cab.

1113. In loading or unloading crawler cranes to or from railroad cars by use of ramps, be sure to have travel brakes and clutches set so as to operate evenly on both sides. If brakes are set to operate in one direction on one side and the opposite direction on the other side, or if the drive clutch is engaged on one side and disengaged on the other side, the crane may run off the side of ramp.
1114. When cranes are equipped with warning whistles or horns, they must be kept in good working condition.

1115. In operating a Clamshell Bucket, the closing and hoisting cable should be attached to the smaller drum and the holding and lowering cable should be attached to the larger drum. The clutch on holding-line drum should be adjusted just tight enough to take up the slack on holding line. This will keep the holding-line tight, so that when the clamshell is opened it will not fall a short distance, which causes undue strain on cable and crane. If holding-line clutch is too tight the bucket will not dig properly and bucket will open while being hoisted.

1116. At the end of each working tour of a crane, the operator must not leave crane until hand brakes are set, boom is in locked position, and running gear has been blocked, anchored or otherwise secured.

1117. No crane should be required to lift loads in excess of the posted capacities. These capacities apply only when the load is directly underneath the hoisting block.

1118. The rated capacities are maximum allowable and care must be taken not to overstrain the crane by exceeding the capacity indicated for any radius.

1119. The radius of a Boom-type or Wrecking Crane is the horizontal distance between the centers of the hoisting hook and the crane's center pin.

1120. Care should be taken in rapid slewing that the load does not swing out beyond the radius at which it can be safely handled.

1121. Before lifting loads without outriggers, the steel wedges, chained to the car, must be placed between the car and trucks to take the strain off the truck springs.

1122. When crane is equipped with outriggers, and these are blocked, car truck wedges should not be used.

1123. Do not depend upon rail clamps for heavy service.

1124. When heavy loads are to be handled, the car should be made as nearly level as possible by driving wooden wedges under the outriggers when so equipped.

1125. When crawler cranes are used on top of flat or gondola cars on a curve, plank should be placed under the lower tread as one runway of crawler, of approximately the same thickness as the elevation of the curve, so that the crane base in operation will be practically level.

1126. All loads may be lowered, by the brake alone, with the hoisting clutch out. With heavy loads, when accuracy is required, the hoisting clutch may be thrown in, and with the reverse lever thrown to the lowering side, without the admission of power the load may be easily lowered into place by means of the brake.

1127. Loads must not be lifted when located to one side of the boom, but crane must be turned so the boom is directly over the load before hoisting same.

1128. Heavy loads must not be rolled over on the ground by turning the crane.

1129. Many of the motions of hoisting, turning, traveling and varying the radius may be operated together and much time saved.

1130. Booms and supporting frames, when in proximity to overhead electrification wires, power wires, and electrical apparatus, must be grounded in accordance with Chief Mechanical Officer's plan D-448643, Roadway Machines - Maintenance and Construction - Grounding Details.

1131. The stated capacities of boom-type cranes are maximums and should not be exceeded. It is not unusual for crane men to attempt to do some job quickly and estimate
the weight of a certain load too low or else knowingly handle weights beyond the rated capacity at the radius used. This is always "taking a chance" with the possibility of a serious accident. The various leverages inherent in the construction of a boom-type crane multiply a moderate overload very greatly upon some important details of the crane, causing an excessive overload.

1132. When the load at which the crane ropes are pulling is not vertically below the hoisting sheaves on the boom, the leverage of the load on the crane is increased and greater strains are imposed. For example: When the crane boom is at 45-degree angle and the ropes are pulling at a load placed some distance ahead of the crane and make an angle of 90 degrees with the boom, the effect is the same on many parts of the crane as if the same rope pull were being exerted with the boom at maximum radius and the ropes vertical.

1133. All boom-type cranes have greater capacity the shorter the radius utilized. When arranging to lift a heavy load always have the crane as close as possible to it, keeping the radius less than the maximum allowable radius for that load according to the ratings of the crane to be used.

1134. Very unusual stresses are imposed upon a boom-type crane by making side pulls of heavy objects. This should be avoided entirely as it is too dangerous a proceeding to be attempted. In these side pulls the boom is not supported rigidly by the boom ropes as in making vertical lifts, and the boom has to resist the side pull as a cantilever beam when it is designed to act as a column. Making side pulls is a dangerous practice.

1135. With boom at short radius and no load on boom, care must be taken to guard against going over backwards when slewing boom at right angles to track, especially when coal and water tanks are full and if working on a curve or where one rail is elevated.

1136. Block under the outrigger on the side away from the load (or under middle of side sill if outriggers are not furnished) and avoid the chance of overturning backwards.

1137. The condition of tracks under boom-type cranes is important to safeguard crane stability. A sudden settling of the rear rail, due to concentrated loading under the heavy rear end of a crane, may cause tipping over backwards. Accidents of this kind have also been caused by snapping of sling chains or slipping of hitches when the boom has recoiled and caused crane to go over backward. Blocking the crane on the side away from the load wherever possible is a safety first precaution that should always be taken.

1138. In negotiating sharp curves, keep the heaviest part of the crane forward and to the outside of the curve. There will then be a minimum chance of the flanges mounting the rail.

1139. Do not make a practice of using clutches as brakes.

1140. The clutch should not be used as a brake excessively when slewing, and any retarding action applied by the operator through the reversing clutch should be done very gently to avoid undue shock to the machinery, which would otherwise severely rack the mechanism on any size crane.

1141. Ashes should never be allowed to accumulate under the grates of a coal-fired boiler. The ash pit should be cleaned out as often as necessary to accomplish this.

1142. Brake bands with asbestos composition linings can be thoroughly cleaned with kerosene and made to act evenly and properly even after becoming gummed up with oil or carbon.

1143. The brake bands should release evenly around the circumference of the drum. On important brakes substantial brackets with setscrews at frequent intervals are provided to insure an even release. See that these setscrews are ad-
justed to prevent the band releasing too much at any point.

1144. If the brake band does not fit the drum properly on account of being sprung in removal or application to the drum, apply the brake strongly and peen with ball end of a hammer along the length of the band that does not fit. It may be necessary, in order to remove kinks from the brake band where it may be binding upon the drum, to insert blocks under the band and bend the band as desired over these blocks by hammering it. The application of an additional setscrew or bracket to constrain the band when released may be advisable under certain conditions to prevent accumulation of the release at any one point.

1145. Proper operation of the brake bands on the hoisting drums is one of the most important points in efficient crane service. Care regarding the above points will increase the work done by the machine.

Steam Operation:

1146. The reverse lever controls the engine link motion. When this lever is pushed forward from center position, the crane will raise its load and lower its boom, either singly or simultaneously. In like manner, when reverse lever is pulled back of center, the crane will lower its load and raise its boom. The double slewing clutches permit slewing in either direction whether reverse lever is forward or back.

1147. With reverse lever at either extreme position, there is practically no expansion of steam in the cylinders and live steam is being admitted nearly full stroke. The intermediate notches between the center position and either extreme provide points where reverse lever may be set to allow the engine to run in either direction with cut-off at about one-third stroke -- thus greatly lessening steam consumption. These intermediate points may be used to advantage when propelling.

1148. Always use a wrecking frog or car replacer (or its equivalent) to rerail an 8-wheel crane. Haul the crane back on the track by some external power.

Preparing Crane for Transportation:

1149. In preparing crane for transportation BE SURE THAT WEDGES ARE REMOVED FROM BETWEEN CAR AND TRUCKS.

1150. On self-propelling cranes slide both shifting pinions under the car out of mesh. A little jarring of the gears, by means of the reverse lever and a little power, will allow the gears to slip out or into place. After sliding these gears back into mesh, be sure no strain is left on the springs.

1151. Dead cranes moving over the road must comply with A.A.R. loading rules.

1152. Hold-downs and locking pins must be used to secure rotating works to car body.

1153. When boom has been removed for an extended trip, crane must be prepared in conformity with A.A.R. loading rules.

1154. On wrecking cranes where guy ropes are provided between boom and corners of car, apply these before attaching rear extension guys, and tighten them by raising boom carefully against them. Then tighten rear jack screws a second time and apply rear extension guy rods. Locking pins must also be used.

Care of Crane Rollers:

1155. The roller patch should be kept clean and free from grease and oil. Then there will be no tendency for the rollers to slide if their bushings are properly lubricated.

1156. If any roller shows a tendency to slide instead of rolling, there is some definite trouble to be discovered. Take the roller out and examine the bushing and oil holes. Rollers
may be started rolling by sprinkling a little sand on the roller path but this should be cleaned off immediately and should not become a regular practice.

1157. Hook-type rollers must be maintained at a minimum of from .020 to .030 of an inch clearance at all times.

1158. Standard hand signals as per Safety Rules S-7C will govern movements of power hoisting equipment.

**Air Brakes and Air Operating Controls:**

1159. Operators of cranes equipped with air brakes or air-operating controls will be instructed in their operation.

1160. The air brake used on locomotive-type crane is a combination of parts controlled and operated by compressed air and by which the motion of the crane is retarded or stopped.

1161. At the start of each tour of work the operator must determine that air brakes are functioning properly by actual test for proper application and release of brakes. He will also listen for air leaks.

1162. The essential parts of an air-brake system are:

(a) Air compressor with governor and unloader.
(b) Gauges.
(c) Main reservoir with automatic and independent brake valves.
(d) Brake pipe feed valves.
(e) Reducing valve.
(f) Distributing valve.
(g) Brake cylinders.
(h) Dirt collectors.
(i) Cut-out cocks.
(j) Piping and hose.

1163. The standard main reservoir pressure is 80 to 100 pounds, and brake pipe pressure is 80 to 90 pounds.

1164. Air compressors are of the two-cylinder, single-stage, wet sump type and oil must be changed after each 50 hours of operation.

1165. To provide for sufficient air passing through air inlet strainers, and to prevent overheating of compressor, the inlet strainers must be cleaned and oiled after each 50 hours of service.

1166. Water, caused by condensation in main reservoir and traps, must be drained out at the end of each working tour. This to prevent washing out of lubrication and brake mechanism failures.

1167. By manually holding compressor unloader in closed position, the pressure in main reservoir should be raised until safety valve operates or pressure has reached 120 pounds. If safety valve does not operate before reservoir pressure has reached 120 pounds, the safety valve should be considered as defective, be immediately removed from service and replaced by another pre-tested valve.

1168. Operators, at the start of each tour of duty, will determine, by actual test, that all air controls are functioning properly and will listen for air leaks.

1169. The essential parts of an air control system comprise:

(a) Operating levers.
(b) Air flex valves.
(c) Actuating cylinders.
(d) Pipe, tube and hose lines.
(e) Dirt and water traps.
CONCRETE MIXERS

1200. In setting up a concrete mixer for operation, it should be level, with the wheels blocked and raised off the ground if possible.

1201. Before starting the engine:
   (a) Inspect moving parts of the machine to insure that they are free to move without damage.
   (b) Inspect skip cables and replace if necessary for safe operation.
   (c) See that all parts of machine are properly lubricated.

1202. The mixing drum, blades, skip and cables must be kept clean, correctly adjusted, and properly maintained.

1203. To reduce the accumulation of cement in the mixing drum and skip at the end of the day’s work:
   (a) Place a half charge of coarse aggregate and a full charge of water in the machine.
   (b) Run the mixer for about five minutes, then dump it.
   (c) Wash all parts with water.

1204. The mixing drum and skip must not be struck hard with any instrument that will cause damage.

1205. Water should be drained from the tank, valves, and hose lines:
   (a) At the close of the day’s work in freezing weather.
   (b) If the machine is to remain idle.
   (c) When machine is being shipped from one location to another.

1206. Keep water tank, supply lines and fittings free from leaks.

1207. Hot water should not be used in a mixer unless it is designed for this use. To do so will result in damage to the valves.

1208. Road materials or other bituminous or oily mixes must be made in mixers which have been assigned for that service only, and the drums must be thoroughly cleaned with kerosene after using.

1209. When not in use these machines should be cleaned and coated lightly with oil to prevent rusting.
CEMENT GUNS

1220. Sand should be screened so as to be free of large pebbles or foreign material which would clog the nozzle of gun.

1221. The agitator must be clean and in good working condition before starting to operate the machine.

1222. All gaskets in gun should be kept clean and in good condition to maintain air-tight connections.

1223. In case work should be stopped for a short while, the nozzle should be laid in downward position so that, in case of leak in water valve, the water will not run back in the cement hose.

1224. All cement hose lines must be kept perfectly clean and dry inside. When not in use, hose lines should be coiled to prevent kinks and care should be taken to prevent heavy material being placed on them.

1225. At the end of the day's work, clean all parts, including gun, nozzle, agitator, and hose.
CONVEYORS - PORTABLE
ENDLESS BELT AND BUCKET TYPES

1250. DESCRIPTION: These machines are made in various lengths, widths, and capacities. The same is true of the construction and type of mounting, depending upon the purpose for which the equipment is designed and the type of materials to be handled. In general, the machine consists of a power unit and a drive mechanism which revolves an endless belt, or a parallel endless chain with bucket, over two widely separated pulleys or sprockets, supported by a frame.

ATTACHMENTS: Swivel spouts, belt scrapers, belt cleats, and various types of buckets.

USE: For handling materials of all kinds. The belt type is suitable for use where the angle of incline does not exceed approximately 20 degrees from the horizontal.

1251. Before putting the machine into operation, inspect the moving parts to insure that there are no obstructions which will prevent free movement.

1252. During operation, an inspection should be made to ensure that:
(a) The belt is running true on the pulleys and that it is centered.
(b) The guide rollers and belt supports are free to revolve.

1253. Endless belts should be kept tight enough to prevent drive pulley from slipping, and excessive sag on the return.

1254. Run power unit and conveyor at speed recommended by manufacturer.

1255. Keep surplus material cleared away from foot of machine so that belts will not be damaged.
DISCERS

1300. The discers in use consist of Class No. 4 motor cars equipped with a suitable overhead frame on which two worm-geared winches are mounted so that they can be cranked by men seated on the deck of the motor car.

1301. Seven discs are mounted on an arm on each side of the car. These arms are adjustable at either end so they can be made to cover the area desired.

1302. The disc assemblies are connected to the winches and hinged on the side of the car so that the trackmen at the winches can regulate the depth of cut and lift them over obstructions, as directed by the Operator.

1303. Wear develops between the disc backing plate and the bearing housings. This must be taken up promptly by removing the back cover plate of the housing and tightening the nut on the disc shaft. If this will not take it up, a washer must be inserted under the nut.

1304. The discs' shaft housings must be forced full of grease in the morning and at noon, so that grease is extruded around the disc backing plate to prevent the entrance of dirt.

1305. A chain is provided to support the front end of the discer arm from the front handrail of the motor car, to prevent it from dropping down and raising the rear end of the discer arm. A $\frac{3}{4}$" drag chain is provided so that a loop of it will drag over the discer ballast to remove furrows.

1306. The successful operation of this machine depends on the intelligence of the Operator in adjusting relative depth of discs' angularity of arm and angularity of discs to the arm. Where vegetation is dense, it is necessary to apply additional weight on the discer arms to cut through it. A sufficient number of trips must be made to destroy the vegetation. One thousand (1,000) pounds of counterweight should be carried over the rear axle of the car.

1307. Some discers are driven by all four wheels, others by only two; where there is two-wheel drive, the 1000-pound counterweight must be carried over the drive axle.

1308. When discer is operated over the road with discer arm raised, there must be a man holding each winch handle, or the two arms must be securely fastened together or to the upright frame of the discer, so that arms cannot drop.
DRILLS - RAIL AND BONDING

1350. Drill bits must be fastened firmly in chuck, correctly aligned, and should not be changed while engine is running.

1351. Dull or improperly sharpened bits should not be used.

1352. When sharpening, the cutting edge should be ground to the full width of the drill bit and at the proper angle.

1353. Sharpening without the use of a guide and gauge is not recommended.

1354. To prolong the life of drill bits:
(a) Use water or some other cooling liquid.
(b) Place cup grease on point of bit before each drilling.

1355. Drill should be level, and at right angle to the rail.

1356. Maintain uniform feeding pressure and reduce pressure as the bit point breaks through on the opposite side of rail.

1357. Do not exceed manufacturer's recommended speed.

1358. Slow drilling speed will make bits last longer.

1359. Do not drill into half blind holes, or through a bolt hole in an angle bar if it can be avoided.

1360. If necessary to drill bolt holes in rail with the angle bar in place, care must be exercised to place the drill in position to prevent bit from contacting edge of bolt hole in angle bar.
EARTH BORERS

1400. Instructions on Autotucks or Tractors will govern, depending on whether borer is mounted on autotruck or tractor.

1401. Before starting, check boring head transmission case, intermediate case, clutch case, etc. for the proper quantity of lubricant.

1402. In setting up, first locate machine so that boring auger will be positioned where hole is to be bored, then raise boom to vertical position. After boring head has been set to desired location, the mast of the machine should be securely clamped in position. The power unit of this equipment should be kept as level, as possible while engine is running.

1403. When boring holes the feed speed should be suited to the nature of the earth to be bored and must not be in excess of manufacturer's recommended speed.

1404. When auger is loaded it must be stopped, raised out of the hole, and rotated to throw off dirt. This must be repeated until the hole is of desired depth.

1405. If rock or other resistant substance is struck while digging, stop immediately and investigate with digging bar, shovel or other tool.

1406. If ground is wet, take less dirt out on auger. The suction created by pulling auger out of hole with load of dirt causes one of the most severe stresses on the machine.

1407. All employees should keep away from the auger while it is revolving, except as may be necessary while taking a log of the drillings.

1408. Standard bolts, with cotter key, should be used to connect auger sections together.

1409. Digging blade and digging point should be kept in good condition, and replaced when badly worn. The blade should extend about one inch beyond circumference of digging head or auger.

1410. Before traveling on highway, the digging mast must be in line with center of truck and securely locked. Also, the digging head and spindle must be securely clamped to avoid falling back of truck. On types of borers where the digging head extends beyond the rear end of truck, the extending portion must be protected by red flag or red lamp.
**TIE BORERS**

1450. Drill bits must be fastened firmly in chuck and correctly aligned.

1451. Dull bits should not be used.

1452. When sharpening, the cutting edge should be ground to the full width of the drill bit and at the proper angle.

1453. Sharpening bits without the use of a guide and a gauge is not recommended.

1454. When drilling, drills must be spotted directly over tie plate holes.

1455. Do not insert the drill bit into the hole in the tie plate until the machine has come to a complete stop.

1456. Feeding pressure should be applied constantly, gradually, but excessive pressure should be avoided.

1457. Do not exceed manufacturer's recommended speed.

1458. If the machine is equipped with a depth gauge, it should be kept tight and in proper adjustment.

1459. If machine is equipped with an exhaust pipe extension to blow wood chips away from the hole, exercise care to prevent injury when setting the machine off or on the track, or in making adjustments near it.
ELECTRIC GENERATORS - GENERAL

1500. When a generator is set up for operation it should be in a level position and should be firmly blocked.

1501. See that the drive is in proper alignment and adjustment.

1502. All electrical contacts should be kept tight, clean, and bright.

1503. Oil and grease should be kept off rubber insulation.

1504. Cable connections should be disconnected with a straight pull.

1505. To avoid incorrect oil level in oil-well-type bearings, never put oil in the wells when machine is running. Flush out and refill bearings with fresh oil at necessary intervals.

1506. If generator is of the slip ring type, the brushes should make full contact with the rings and be set so as not to overlap the edge of same. A firm and even tension should be maintained on all brushes and they should move freely in holders. Rings must not be lubricated.

1507. To obtain correct voltage, the recommended generator speed must be maintained. The generator should not be operated below or above the rated speed.

1508. If current does not come up to proper voltage, as indicated by voltmeter if so equipped, or evidenced by slowing down of the tools, something is wrong and generator should be shut down until a correction is made. Examine for burned-out fuses and check all connections and contacts to determine if they are loose, broken or pitted. It may also be caused by overloading the power plant, or there may be a short circuit or some other defect in the wiring or in the tools.

1509. The load should not be greater than the rated capacity of the generator.

1510. If some, or all, of the tools being operated from a generator fail to operate, it is generally an indication that the power supply line is open at some point. The connections, fuses, and tubes should be examined for defects.

1511. When three-phase power is used, special care must be exercised to see that a single fuse is not blown and that there are no loose connections or shorts in the cables or motors. If a single fuse is blown or one conductor in the cable is broken, it will cause single-phasing, which may result in serious overheating of the generator and tools, and also serious reduction in power of the tools. Three-phase motors usually will not start if the line has single-phased.

1512. The tension on brushes should be equal and the brushes should fit in their holders so they are free to move without sticking or binding, but not so loose that they chatter or get out of alignment.

1513. If the voltmeter does not operate correctly, the connections at the brushes and brushholders should be examined.

1514. Collector ring brushes should make good contact and should not be stuck in their holders. The rings should be cleaned if they become dull or pitted, and should not be lubricated.

1515. A frequent cause of generator trouble is an accumulation of oil and dirt on brushes, brushholders, commutator, and collector rings. The interior of a generator should be cleaned by suction or by blowing with low-pressure compressed air, or a hand bellows, making sure that the air is free from moisture. A moisture-soaked generator should be dried out thoroughly before it is operated. The exterior should be cleaned by wiping with a lint-free cloth.
1516. Commutator, brushes, and brushholders should be cleaned with a lint-free clean cloth. If these parts are unusually dirty or sticky, the cleaning may be done with carbon tetrachloride or other approved cleaner, while the generator is at rest.

1517. If the commutator becomes rough or grooved it should be smoothed with a commutator cleaning stone. No. 00 sandpaper may be used if a stone is not available. Never use emery cloth or emery paper. After cleaning, the dust should be blown away.

1518. If there is evidence of excessive commutator sparking, the cause should be located and corrected at once. Sparking may be caused by one or more of the following:
   (a) Rough, flat, or high spots on the commutator surface.
   (b) Brushes not moving freely in brushholders.
   (c) Insufficient brush tension.
   (d) Excessive load, voltage or vibration.
   (e) Open-circuited or short-circuited armature and field windings.
   (f) Accumulation of carbon or dirt in the undercut slots.
   (g) Dirty or glazed brushes, or dirty commutator.
   (h) Brushes not in correct position.
   (i) Poor face on brushes, if replacement brushes have just been installed.
   (j) Whipping armature.
   (k) Defective bearings.

1519. Before making any repairs to a generator the engine should be stopped.

1520. Repairs to generators must be made by a qualified man.

1521. An entire set of brushes should be always available.

1522. In ordering brushes, specify the manufacturer's name and generator Serial Number.
WELDING GENERATORS

1550. Instructions for Electric Generators - General, paragraphs 1500 - 1522, will apply, as well as Letter of General Practice No. 216.

1551. For Crawler Tractor Mounting, Instructions for Crawler-type Air Compressors, paragraphs 361 - 366, will apply.

1552. Properly connect the welding cables to the terminals.

1553. Start the set, and adjust the voltage by means of the rheostat and set the polarity as desired by means of the polarity switch, when the machine is so equipped.

1554. Refer to table on the machine for the setting of the current control switch or switches to obtain the desired current, then set the current control switch or switches as indicated.

1555. To read the welding current, press the button, when provided, below the voltmeter.

1556. Different operators work with different voltage settings for the various sizes of welding rod, but, in general, the best performance may be expected when the highest open circuit voltage is used which will give the correct welding current.
GRADERS -- MOTOR OR ROAD PATROL

1600. This is an off-track machine consisting of a power unit and a heavy-duty automotive-type tandem drive mechanism mounted in a frame and supported by pneumatic-tired wheels. An arch extending from the rear frame to the front of the machine is supported by two pneumatic-tired wheels and serves as a support for a cutting blade which, through a controlling mechanism, may be revolved, swung from side to side, or raised to a perpendicular position at either side of the machine.

1601. The employee assigned to operate these machines shall be governed by the applicable rules covering automobiles and trucks.

1602. The employee assigned to operate this equipment should not permit unauthorized persons to ride upon, operate, repair, or make adjustments to it.

1603. When moving from one location to another on a public highway or road, the operator must be governed by local and state regulations.

1604. In congested areas, or where conditions make it necessary for safe movement, an employee should be assigned to assist the operator to protect against personal injury or damage to property.

1605. When moving from one location to another, operators shall set the blade at such angle that the edges of it will not extend beyond the sides of the machine, and must take the necessary precautions to prevent blade from moving.

1606. The operator shall make daily inspection of the machine to insure that it is in safe operating condition.

1607. See that the gears, pinion, and rack which controls the cutting blade are in proper adjustment.

1608. Keep the replaceable cutting-edge bolts tightened.

1609. Replace badly worn or broken cutting edges.

1610. The operator shall make daily inspection of tires and, if practicable, remove any foreign matter which might be imbedded in them.

1611. Tire pressures shall be checked frequently, at least once each week, to insure that the tires are properly inflated.

1612. To avoid personal injury by failure of tire or lock ring, all concerned shall be governed by the following while inflating tires:
   (a) Keep away from the side of the tire.
   (b) Take a position as near the tread as possible.
   (c) Inflate slowly and see that lock ring is properly seated.

1613. The rear tires shall be installed with the arrow on sidewall pointing in direction of forward rotation.

1614. Low pressure front tires, when marked with an arrow, should be installed with this arrow pointing in the direction opposite to forward rotation.

GRADALLS

GRINDERS - ALL TYPES

1700. Instructions for the Use and Care of Abrasive (Grinding) Wheels, per Letter of General Practice No. 219, apply.

1701. Grinding wheel guards must be kept in place and in good condition.

1702. Engines of grinders should never be started while a grinding wheel is in contact with any surface.

1703. At start of each tour of work, after engine and grinding wheel have been running a sufficient length of time to reach their normal operating temperatures, and before grinding wheel is applied to work, the speed of grinding wheel must be checked at the grinding wheel spindle.

1704. GRINDING WHEELS MAY NOT BE RUN at speeds greater than those indicated as safe revolutions per minute for various grinding wheels, listed in Letter of General Practice No. 219.

1705. Overload clutches must be maintained in good condition.

1706. Grinding wheels not being used must be protected from weather by use of a suitable cover.

1707. Safe wheel guards are furnished for all spindles. The operator must keep them in order and must use them constantly for his own safety.
FLEXIBLE SHAFTS AND GRINDER ATTACHMENTS

1720. When attaching a flexible shaft to a power unit, it must be known that the shaft is wound in the correct direction, so that the twist imparted by the power unit tends to tighten the winding on the outside of the shaft rather than unwind it.

1721. Connections on ends of flexible shafts must be threaded, so that both wheel and machine ends will tend to tighten as they revolve.

1722. Flexible shafts must be operated without short bends or kinks. At all times they should be kept as nearly straight as possible and in a horizontal position, if possible. No heavy objects should be placed on them.

1723. When a flexible shaft begins to buckle, it is either being worked beyond its capacity or some defect has developed.

1724. Flexible shaft cores require particular care that proper amount of Ball Bearing Grease, Material Catalog Ref. No. 37-179, is used as lubricant. When placed in service, and after each 40 hours of use, the flexible shaft core must be inspected to determine that it is properly lubricated by having not more than a slight film of grease throughout its length. Too much grease applied to cores will result in overheating and damage to core and housing.

1725. After each 160 hours of operation of a flexible shaft, the core must be removed from the housing and all grit and dirt removed from it by washing it in kerosene, Material Catalog Ref. No. 37-46, and relubricated with slight film of grease after it has been thoroughly dried.

1726. Special care must be exercised to prevent greasy cores, open ends of housings, etc., from coming in contact with dirt, sand, cinders, etc. A clean board or other clean surface should be used on which to lay parts.

1727. When shipments of this equipment are made, all exposed parts, including cores, open ends of housings, connections, coupling nuts, etc., must be shipped together and be well wrapped or packed to prevent loss or damage in transit.

1728. Protection caps must be kept over the end of hand-piece or spindle housing of any other attachment when they are not in use or fastened to a flexible shaft.
P-11 AND P-11-S CROSS GRINDERS

1730. Grinder instructions, section 1700, and Flexible Shaft and Grinder Attachments instructions, section 1720, apply.

1731. Locate the machine by means of the indicator on each end of frame in a position to take the cut that is desired across the joint or rail end, and clamp it by means of the adjustment clamp provided on each end of the frame, which will place the flanges of the track wheels against the gauge side of the rail. If track wheels are not pulled up squarely against the gauge side of the rail and held there sufficiently tight to prevent the slightest movement of the machine, the grinding wheel is liable to break. By means of the upright handle provided on the carriage, pull the grinder back and forth over the joint and at the same time manipulate the lever operating the vertical feed, but do not overcrowd the grinding wheel by the application of excessive pressure on the feed.

1732. When lifting machines to or from the track, or starting engine, place carriage in center of frame and lock it by means of spring stop provided for that purpose.

1733. When turning or pivoting the motor and spindle housing of P-11-S machine for cross-grinding opposite rail, push down on feed control handle far enough to allow grinding wheel guard to clear frame. USE HANDLE FASTENED TO ENGINE in lieu of FEED CONTROL HANDLE when turning machine, to avoid damage to grinding wheel and guard.
P-16 SWITCH AND STOCK RAIL GRINDERS

1740. Grinder instructions, section 1700, and Flexible Shaft and Grinder Attachments instructions, section 1720, apply.

1741. Attach the support wheel to the machine and set the machine on the stock rail.

1742. Loosen the swivel locking device on top of the upright housing situated in the center of the machine.

1743. Drop the grinder head, which is held by means of a bracket handle locking device provided on the push handle of the machine, and turn the lateral adjustment hand wheel provided at the top of push handle until the grinding wheel is against the side of the stock rail head.

1744. With the grinding wheel against and in alignment with the stock rail, lock the swivel on top of upright housing and start the engine. For operating speed, set the accelerator in the second notch, which is the proper speed for a 10" diameter cup wheel. Hold push and grinder head handles in operating position. Move the machine back and forth and occasionally, as required, operate the grinding wheel feed until all the overflowed metal is completely removed. To grind the switch point, open the swivel lock, and by means of the lateral adjustment hand wheel, shift the grinding wheel against the surface of switch point. Always adjust the swivel lock slightly loose so as to allow the grinding wheel to follow the alignment of the switch point while the machine is being moved back and forth on the stock rail in a straight line.
P-22 AND P-44 FLEXIBLE SHAFT GRINDERS

1750. Grinder instructions, section 1700, and Flexible Shaft and Grinder Attachments instructions, section 1720, apply.

1751. A spring stop is provided on the turntable for locking it. To unlock, pull up the spring stop and turn it slightly. To lock, pull it up and turn until it again engages.

1752. To change from angle-type to straight-type hand piece, or vice versa, unscrew the nut nearest to flexible shaft.

1753. To disconnect the flexible shaft from the machine, unscrew the large hexagon nut on the countershaft housing and pull out.

1754. An idler is provided on the engine for slowing down the speed. To operate the idler, push the small lever slightly to right, then downward. To resume normal speed, likewise push the lever slightly to right, then upward.

1755. The drive consists of a sheave on the engine shaft and one on the countershaft, connected with V-belts. No lubrication is required for belts. Keep the belts reasonably tight by means of the adjustment provided on the countershaft housing.

1756. The countershaft housing has two ball bearings and is provided with Alemite fittings. Inject grease in these bearings once a week.

1757. The pneumatic tire transport wheel runs in ball bearings and should be greased once every two weeks.

1758. The turntable on which the engine is mounted is equipped with two thrust ball bearings in the bottom. These bearings should be greased thoroughly once every six months.

1759. The spindle in hand piece operates in ball bearings and should be greased thoroughly each week of service.

1760. Spindles used in P-22 type straight hand pieces must have, on the wheel end, one portion 1/4" right-hand thread and other portion 1/8" left-hand thread for application of locknut.

1761. The 1/8" thread will be used when steel-back cup wheel 8" x 1" x 1/8" is applied.

1762. When steel-back cup wheel 8" x 1" x 1/8" is applied, the long bushing nut (Part No. 26-B) must be applied, nut portion first.

1763. When rim-cutting wheel 8" x 1" x 1" is applied, long bushing nut (Part No. 26-B) must be applied, bushing portion first.

1764. When applying cross-cutting or slotting wheel 8" x 3/4" x 1", short bushing nut (Part No. 26-A) must be applied, bushing end first. Long bushing nut (Part No. 26-B) must be applied, nut portion first, to protect threads on spindle.
NORDBERG FLEXIBLE ARM GRINDERS

1770. Grinder instructions, section 1700, and Flexible Shaft and Grinder Attachments instructions, section 1720, apply.

1771. For stock rail grinding: Place transverse operating carriage within two inches of truck wheels and lock it. Have revolving frame unlocked while grinding stock rails and switch points. Move flexible arm over stock rail to attach spring to hook welded at corner of transverse carriage.

1772. With grinding wheel against side of stock rail, adjust depth of grinding wheel by inserting pin through one of the holes in upright frame between which flexible arm moves.

1773. Move machine back and forth to remove overflow of rail metal. The grinding head can be adjusted by notched quadrant and a lock for undercutting stock rails and beveling gauge side of switch rails.

1774. For cross-grinding with center transverse carriage between truck wheels: Adjustment of fastening clamp, toothed rack on truck frame and wedged lever must be made to prevent movement of machine on track. Revolving frame must be locked by use of hinged lock at engine base. To prevent flexible arm from swinging, apply the removable grinder arm guides and fasten them with the provided thumb screws. Center grinding wheel over location where cut is to be made and hold it firm by use of rail fork. Balance flexible arm by use of chain links.

1775. For spot surface, flangeway and longitudinal groove grinding: Release flexible arm so it moves freely up or down. Insert pin back of and above pivot arm to which flexible arm is attached. Move flexible arm to position over top of rail and lock transverse carriage against revolving.
GROUT MACHINES - PNEUMATIC

1800. Satisfactory performance of this equipment is dependent upon proper lubrication and the care given the pressure vessel and lines, and the employee in direct charge of each unit is responsible for the proper care of these items.

1801. The air pressure regulating valve is set at 40 lbs., and must not be changed without proper authority.

1802. A standard train line valve should be used at the end of the grout hose, to control flow while changing hose from one injection point to another.

1803. During the injection process, the employee assigned to operate control valve should keep his hand on hose link back of control valve, to determine whether or not the grout is moving through the line and point. If the flow of grout ceases suddenly, he shall close the train line valve, disconnect grout hose from the injection point, and determine and correct the cause of stoppage.

1804. Employee must exercise care to avoid personal injury in disconnecting hose from grouting point. Glad-hand hose connection should be broken away from the body rather than toward it.

1805. Flush and clean vessel and hose at least twice daily. This must be done when it is necessary to cease operations for lunch, while moving, or when operations are discontinued for short periods.

1806. After injection point has been removed from the ground, place it in the water tank immediately. Clean and check it for obstructions before redriving.

1807. If equipment is used in temperature below freezing, apply air to hose lines and injection points after cleaning.
GROUT MACHINES - HYDRAULIC

1810. The applicable instructions governing Concrete Mixers, section 1200, and Grout Machines - Pneumatic, section 1800, should also be followed.

1811. The nature of the work done by this machine necessitates additional precautions in lubrication. Mixer shafts, crankshafts, bearings, etc., must be lubricated several times per day.

1812. This machine should be kept level while it is in operation.

1813. In making adjustments on rubber packing rings, care must be exercised that rubber does not fit cylinder too tightly. It shall not be so tight that it cannot be moved by hand or with a lightweight bar when the piston is at the center of the stroke.

1814. Keep the main drive belt in proper adjustment, but do not use dressing to prevent slipping.

1815. Do not operate while cylinders are dry. To do so will cause rubber packing ring to stick to cylinder wall, causing serious damage.

1816. This equipment must be thoroughly cleaned at the close of the day’s work.

1817. Do not let machines stand through noon hour with grout mix in hose, valves, mixing chamber or cylinders.
JACKS - POWER TRACK, NORDBERG

1900. The employees assigned to operate this machine shall make sure that:

(a) Dirt does not enter the hydraulic oil reservoir or hose lines.

(b) There is sufficient oil in the reservoir. (1" below the top when rams are in top position.)

(c) Rail clamps are in proper adjustment and will not slip while lift is being made.

(d) All bolts and nuts are kept tight.

(e) The machine is kept clean.

1901. Rail clamps shall be kept in adjustment to provide \( \frac{3}{4} \)" clearance between the bottom of the ball of the rail and the clamp.

1902. The employee making these adjustments shall do so by turning the rail clamp rod nuts at the top of the jack frame.

1903. Adjustment of rail clamps shall not be made by turning the clamp rods.

1904. The rail-clamp operating lever shall be locked to prevent clamps from dropping into working position when machine is being moved on the rails.

1905. This machine is not designed for towing and shall be pushed by hand for short moves or loaded upon a push car for long moves.

1906. All employees are prohibited from riding upon this machine, except the operator may do so when necessary to operate it.

1907. The lifting spud shall be placed between the ties, not on top of them.

1908. The lifting spud should be raised only high enough to clear the ties or ballast when moving from one lift to the next.

1909. The employee assigned to operate this machine shall not at any time lower or raise the ram on one side enough to throw the lifting spud out of level as much as 14".

1910. Copper, brass, rubber or other material shall not be used as a substitute for the seamless steel tubing furnished for hydraulic oil lines without proper authority.

1911. The employee assigned to operate this machine shall not attempt to repair or make adjustments to the hydraulic ram, pump, operating valves or relief valves without proper authority.

1912. When the hydraulic power jack is not in use, the ram should be fully retracted to prevent the piston from becoming covered with grit or rust. Place a block under the spud, if necessary, to hold ram in the top position.

1913. If the engine or the hydraulic pump should fail while the jack is under load and it must be removed from the track, the lifting spud may be released by:

(a) Pulling out compression release on engine and turning engine by hand, while holding control valves in proper position.

(b) Carefully removing the high pressure hydraulic line to the ram, and raising the spud with a lining bar or similar tool.
JACKS - TAMPING - POWER
Nordberg

1920. The operator and others concerned in the performance of this machine shall be governed by the applicable instructions covering Jacks - Power Track, Nordberg, section 1900, in addition to the rules which follow:

1921. The lever controlling the tamping head must be held down during the period of tamping to provide maximum effect.

1922. The operator shall manipulate the control levers on the hydraulic jack as necessary to insure that the sighting rail will be the first to reach the desired height; then level the opposite rail as indicated by the leveling device.

1923. The operator shall perform the following before traveling, except while engaged in tamping:
   (a) Release the vibrator drum drive clutch.
   (b) Lock the rail clamps in the raised position.
   (c) Lock the tamping head in the raised position.
   (d) Lock the leveling device in the raised position.
   (e) Remove the sighting gauges, if necessary.

1924. The rail clamps are in proper adjustment when there is a space of $\frac{3}{8}"$ between rail and contact points.

1925. Rail clamp hooks are in proper adjustment when they clear inside edge of ball of rail $\frac{3}{8}"$.

1926. Proper distance between the face of the shaft and the face of the weight bolt nut is $\frac{3}{8}"$ to $\frac{1}{4}"$.

1927. Increasing the space results in greater vibration. Adjust with special wrench so as to provide only enough vibration to produce satisfactory results.

1928. Set the jack spud shoe to suit the average tie spacing by moving the jack frame in the desired direction as necessary to permit tamping bars to enter the crib without interference.

1929. Adjust friction drive as required to maintain $\frac{5}{16}"$ clearance between each side of the cone and the face of reverse bevel friction.
1930. The operator and others concerned in the operation of this machine shall be governed by the applicable instructions under Jacks - Power Track, Nordberg, section 1900, and Jackson Track Maintainers, section 420, and the rules which follow:

1931. Before starting engine, see that over-center clutch is in neutral position.

1932. See that the tamping heads, rail clamps, and jack rams are locked in the raised position.

1933. Operators and others concerned in the operation of this machine shall keep in the clear of the tamping heads and clamping mechanism while machine is being operated.

1934. Observe action of tamping blades, and reverse direction of motor rotation if blades do not move toward the rail when penetrating the ballast section.

1935. Generator and tamping motors must be operated at recommended r.p.m. to prevent damage.

1936. Place the transmission in neutral position if necessary to tow this unit.

1937. Do not use hydraulic brake fluid.


1939. Rail clamps are in proper adjustment when front wheels of the machine are raised \( \frac{3}{4} \)" to \( \frac{3}{4} \)" above ball of rail when making a lift.

1940. The sighting blocks are in proper adjustment for use with standard spot board when the top edge of the block is 12" above the rail ball.

1941. Unless otherwise instructed, adjust motor belts as necessary to provide 17" space between tip of opposing tamping blades.

1942. Unless otherwise instructed, adjust positioning belts to provide 9" space between ball of rail and nearest edge of tamping blade.

1943. Adjust motor limiting belt as required to prevent contact between tamping blade and base of rail when tamping head is at lowest point of travel.

1944. Motor suspension belts are in proper adjustment when tension permits motor sag of about \( \frac{3}{4} \)" between belt supports.

1945. All bolts must be kept tight, paying particular attention to tamping blade bolts.

1946. Adjust tamper workhead stop (bumper) as necessary to prevent damage to workhead ram.
MAGNETS

2000. Inspect the electric cables and connections, chain and lifting cables daily to insure they are in safe operating condition.

2001. Inspect contact bars on the circuit breaker or control switch daily and clean if necessary to prevent burning.

2002. Inspect the electric current cable take-up reel daily to insure against short circuits.

2003. Inspect bolts daily and keep tight or replace if necessary.

2004. Use the tagline to prevent magnet from twisting and causing damage to electric cable.

2005. The electric current to the magnet should be cut off except as required to handle a load, to prevent overheating of the magnet and generator.

2006. Avoid striking the side of the magnet against solid objects.

2007. Magnets should not be used as "skull-crackers".

2008. Keep dust, dirt, and other foreign materials cleaned away from the terminals on the magnet to prevent short circuiting.

2009. Keep the switch box clean and dry.

2010. Magnets should not be placed in water to cool them.

2011. If overheated, take out of service and cool gradually.

2012. When magnet is not in use, it must be stored off the ground on wooden blocks or on idler car of crane to which assigned.

2013. The electric generator furnishing current to the magnet must be serviced as per "Instructions Electric Generators".

RAIL MILLING MACHINES - POWER

2030. To work this machine it is necessary to secure the use of track and then clamp the machine to the rail. Care must be used in feeding cutter so as not to damage or unnecessarily dull the cutter. Overflow metal should be chipped off the head of the rail at the starting point, in order that the cutter may not have to start on hard, cold, rolled metal. The proper cutting compound should be applied in a continual flow. In the housing of stock rails, the work must be done to comply with the specifications of C.E. 78.
MOWING MACHINES - OFF TRACK

2050. The operator in charge of these machines shall not permit unauthorized persons to operate or to ride upon them.

2051. Operators shall exercise care in the operation of this equipment to prevent personal injury and damage to equipment, particularly on rough ground or in going through ditches. If weeds are high and view is obstructed, he should stop and inspect the ground on foot before mowing the weeds.

2052. Operator must exercise extreme care that the cutter bar does not contact signal lines, telegraph and telephone lines, guy wires and other obstructions which might result in personal injury or damage to property.

2053. These machines should not be operated on slopes which are so steep that there is danger of upsetting.

2054. When operating on any slope with the cutter bar on the “uphill” side, operators shall exercise care, when necessary, to raise the bar, to prevent machine from being overturned.

2055. When a machine is being moved and is not engaged in weed cutting, the cutter bars must be raised and locked in that position.

2056. Operators should check tire pressure each morning before operating machine, and keep tires inflated to proper pressure.

2057. Do not operate a mowing machine with guards or ledger plates missing or broken, or with worn section in the sickle bar.

2058. Guard bolts should be kept tight and the guards lined up so that the sickle fits snugly on the ledger plates.

2059. The knife clips shall be kept tight at all times so that the sickel is held flat upon the ledger plate.

2060. Do not operate a mower with a dull knife. Extra knives should be provided so that dull knives may be replaced.

2061. The cutter bar overload release mechanism should be properly maintained. Disconnecting the ignition cutout switch is not recommended.

2062. When necessary to remove vegetation or other material which has accumulated on or near the cutter bar, it must be done with a stick, rod, shovel or other tool which will keep the employee’s hands out of danger.

2063. All employees shall keep hands in the clear of knives and guards when necessary to raise, lower or swing the cutter bar assembly into position by hand.

2064. Repairs or adjustments must not be made with engine running.

2065. Work on cutter bar assembly shall be done when it is in a horizontal position, resting on the ground. If possible, work from side opposite the guard points.

2066. Before changing knife assemblies, the engine shall be shut off and the machine blocked and locked against movement.

2067. No one shall be permitted or required to walk directly in front of the sickle bar while machine is in operation.

MOWING MACHINES - ON TRACK

2070. All employees concerned in the operation of these machines shall be governed by applicable instructions, paragraphs 2050 through 2067.

2071. The engine speed must be controlled as necessary to reduce vibration and produce a smooth operation when cutter bar extensions are used.
2072. The spring clip and bayonet catch, which hold cutter bar in position but release cutter bar when an obstruction is hit, shall be properly maintained.

2073. The release mechanism on swing gate must not be locked.
PILE DRIVERS

3000. All applicable instructions in Letter of General Practice No. 214 - Crane Maintenance Instructions will be observed.

3001. A pile driver-crane, while supporting the leads and hammer, must not be used as a crane to lift heavy loads.

3002. In preparing pile drivers for shipment, the leads must be properly anchored within standard clearance limits and the traveling gear disengaged.

3003. With steam or air hammer, the hammer power pipe should extend nearly half way up the leads in height, so as to save length in hose. There should be an elbow in the end of pipe with the outlet leading down. The hose connects to the elbow and passes around and outside of the leads to the cylinder. The pipe should be provided with a drain cock at the lowest point to eliminate condensation.

3004. Steam hose of an approved type must be used with steam hammers and must be equipped with a safety chain at the hammer connection to provide protection to workmen in the event that the hose is blown off under pressure.

3005. The operator of a pile driver must not be out of reach of the controls at any time in which the unit is moving under its own power, while the pile hammer is suspended, or while the pile hammer is operating.

3006. The pile hammer must be at its designated position in the leads and correctly toggled when the leads are being raised, lowered, or battered.

3007. The full weight of the hammer should rest upon the pile while driving. The hammer line must be entirely slack.

3008. See that keys in ram are always tight. The wooden cushion block becomes gradually compressed when first put to work.

3009. During cold weather when not in use, be sure to open drain cocks.

3010. When ready for driving, raise the hammer to the top of the leads and block it. Swing in the pile and lower the hammer upon it. Slack off hammer line entirely and turn on power.

3011. Three qualified pile driver operators and three qualified firemen must be available for each unit.

3012. Boiler wash, joint inspection and operating test under steam by qualified representatives of the Master Mechanic and District Engineer must be made of each pile driver each month; any repairs required, to be promptly made and copy of report of test and repairs forwarded to Master Mechanic, District Engineer and Regional Engineer.

3013. Each crew of one pile driver operator and one fireman must make above test every third month.

3014. After test, the equipment must be completely drained to prevent possible damage on account of freezing.

3015. Above inspection and repairs include assigned tender, idler car, tool car and equipment.
PNEUMATIC TOOLS

3030. Operator in charge of pneumatic tools must inspect all equipment promptly after the start of his tour of duty and immediately correct defective items or remove them from service.

3031. Dismantling pneumatic tools, for cleaning or repairing, at location other than repairs shops is prohibited.

3032. Pneumatic tools must be laid down and not dropped to the ground.

3033. Striking body of tool to loosen bit or bar from its holder is prohibited.

3034. Pneumatic tools must not be disconnected from the air hose until the supply line valve is closed and pressure released.

3035. Air consumption of all pneumatic tie-tamping tools will be checked annually, preferably during winter season. Air consumed and date of checking will be stenciled, with \( \frac{1}{4} \)-inch steel stencil, on barrel of tool.

3036. Air consumption of each pneumatic tool must be known. Total air consumption of all tools being worked with one compressor must not exceed the free air capacity of the compressor.

3037. Following listed makes of pneumatic tie-tamping tools will be shopped for repair when they consume 12 or more cubic feet of air at 80 lbs. pressure:

- Chicago Pneumatic............ Model CP-3D
- Ingersoll-Rand................. Model MT-4
- Worthington.................... Model WTT-17

All other makes and models will be shopped for repair when they consume 15 or more cubic feet of air at 80 lbs. pressure.

3038. Throttle valves of pneumatic tools must be lubricated with compressor oil at the close of each day's work, to prevent rust as a result of moisture in the air supply.

3039. All pneumatic tools, except those equipped with grease or oil fittings, must be lubricated with Compressor Oil (S.A.E. 10), Material Catalog Ref. No. 37-87, by pouring one or two ounces of oil into the air inlet before starting and every two hours thereafter during operation.

3040. Pneumatic tools equipped with grease fittings must be lubricated with MT-3 Tamper Grease, Material Catalog Ref. No. 37-124, before starting and every two hours of service thereafter.

3041. Pneumatic tools equipped with oil reservoirs must be lubricated by having reservoirs filled with S.A.E. 5 or 5W Oil, Material Catalog Ref. No. 37-338, before start of work and every four hours of service thereafter.

3042. Oil filters and oil passages must be cleaned to permit free passage of oil in tools which, after use, indicate they did not consume oil while being operated.

3043. Sluggish-acting pneumatic tools must be treated by pouring one or two ounces of kerosene into the air inlet, operated for one minute and then properly lubricated.

3044. When ice starts to form around the exhaust ports of pneumatic tools, sufficient alcohol must be fed into supply line to prevent tool from becoming sluggish.

Piston-type Drills and Wrenches

3045. Before starting piston-type pneumatic drills and wrenches, pour a teaspoonful of oil in air inlet. At end of tour of duty lubricate throttle valve with oil. These air motors are packed with grease. After each eight hours of operation grease should be added. This grease vent is closed either with a pipe plug or the dead handle of the tool.
Multi-vane Drills and Grinders

3046. Where air line lubrication is not available, pour a teaspoonful of oil in air inlet and see that oil chamber is full. Every two hours remove and clean the air strainer. At the same time fill oil chamber. If the tool does not run properly, clean air strainer more frequently. If too much or too little oil is being supplied, as indicated by exhaust and consumption of oil, make necessary adjustment with the oiler adjusting screw until oil is visible in the exhaust.

3047. After every 40 hours of operation add grease to the reduction gear housing, governor housing, and ball or roller bearings.

3048. It is important that very little clearance exist between the ends of the rotor and cylinder head; therefore, when new gaskets are applied the thickness should not be any greater than that of the old gasket.

PNEUMATIC MANIFOLDS, HOSE AND PIPELINES

3050. Operator in charge of pneumatic pipelines and tools must inspect all equipment promptly after the start of his tour of duty and immediately correct defective items or remove them from service.

3051. Pipelines and manifolds must be used in accordance with layout indicated on standard plans Nos. 77620 and 77625. Foreign substances such as sparks, cinders, etc. must be blown from them before tools are attached.

3052. Pipeline threads and fittings must be well lubricated and protected with old pipe fittings or other suitable protection while they are being shipped from one location to another or while stored.

3053. Air hose used with M.W. equipment shall be:

- ½" hose - Ref. 46-3671
- 1½" hose - Ref. 46-3672
- 2" hose - Ref. 46-3673
PORTABLE WATER PUMPS

3060. Water pumps shall be set and blocked in a level position as near the water as consistent.

3061. The employee assigned to operate a water pump shall perform the following duties before starting it:

(a) Make sure there is no foreign matter in the pump housing.
(b) Make sure there is priming water in the hopper.
(c) Check for loose hose connections or fittings and tighten if necessary.
(d) In freezing weather, make sure there is no ice in the impeller housing. If found, warm water may be used to melt it.

3062. After the initial prime, most pumps will retain sufficient water for proper operation, but pumps must not be operated without water, except as outlined under paragraph 3070.

3063. The employee assigned to operate it shall check for the following if the pump fails to prime or stops pumping:

(a) Air leaks. (Loose hose connections, porous hose, grease seals.)
(b) Hose or lining collapsed.
(c) Suction strainer plugged.
(d) Suction lift too high.
(e) Liquid too hot for suction lift.
(f) End of suction line too shallow in liquid.
(g) Defective rotary seal or packing.
(h) Foot valve not seating properly.
(i) Sharp kinks in hose or loose hose lining.

3064. Centrifugal pumps shall not be operated without a strainer on this suction line.

3065. Suction line strainers shall be inspected and cleaned at least once a day.

3066. The diameter of the suction line and of the area of the openings in the strainer must not be less than that of the suction line connection on the pump.

3067. The diameter of the discharge line should not be less than the diameter of the pump connection.

3068. If necessary to use a valve to regulate the flow of water on the discharge line, it shall not be closed tight while the pump is running.

3069. All water pumps not in use shall be thoroughly drained when there is danger of freezing or when they are to be shut down for several days.

3070. The employee assigned to drain a pump will proceed as follows:

(a) Remove drain plug at bottom of casing.
(b) Insert stick or wire to remove solids, if necessary.
(c) Start engine and operate pump, not to exceed one minute.
(d) Install and tighten drain plug.

RAIL LIFTERS

4000. Instructions for Internal Combustion Engines - General, paragraphs 60 through 87, and Hydraulic Systems, paragraphs 270 through 289, will apply.

4001. Before starting operation of the machine the operator must be sure the rail-clamping device is in safe working order, so that clamps cannot slip off head of rail.

4002. The engine governor setting is 3200 r.p.m.

4003. The hydraulic relief valve is fluid controlled from the pump and requires no adjustment.
RAIL SAWS, PORTABLE

4020. This machine is designed to cut on the “push” stroke and blades shall be installed with teeth pointing toward adjusting bolt.

4021. Lifting fingers or dogs are properly adjusted when about \(\frac{1}{4}\) inch from ratchet bar with saw at center of cutting or push stroke. Both dogs shall be the same distance from ratchet bar, and must always work independently. They shall not be fastened together.

4022. When the rail clamps are properly adjusted, the portable saw will cling to the rail being cut and does not need other support.

4023. Tighten adjustable rail clamps as necessary to place the saw blade at right angle to the rail, and keep it level so a true cut will result.

4024. The base of the machine should rest firmly against the base of the rail.

4025. Blade shall be kept reasonably tight to insure straight cuts. Blades may stretch slightly during the operation and must be tightened from time to time.

4026. Before starting to cut a rail, check tank provided for coolant, if any, and be sure that the flexible line from the tank is open.

4027. To start the cut, lower the frame and blade onto rail easily, raise frame slightly, and pull the supporting lever forward.

4028. Water or other coolant should be applied to the cutting blade while the machine is in operation.

4029. Do not force saw blade into rail while cutting. Exercise care in starting cut on top of rail which has been hardened by cold rolling.

4030. A sharp blade eliminates the necessity for applying excessive pressure to cut the rail.

4031. The adjustable weight should be placed near the engine when making cuts with new blades. As the blades become dull, the weight should be moved away from the engine, toward the outer end of the beam which supports it. Less weight is required when cutting the web, and the weight should be moved back toward engine, releasing pressure slightly until through the web of the rail.

4032. The saw blade frame should be supported by hand at the finish of the cut to avoid breaking the saw blade.

4033. Moving the machine while a cut is being made will result in a broken blade.

4034. After the cut has been completed, stop the engine, raise the saw blade frame by hand until the lever which supports it will fall into position. Do not raise frame higher than necessary or the machine may be damaged.

4035. The machine should not be left with the ratchets supporting the saw frame. These may become disengaged and permit the saw frame to fall, resulting in damage to property and possibly a personal injury.
SAWS - PORTABLE TIMBER

4050. Portable timber saws used in M.W.& S. service are usually operated by electric motors, compressed air motors, gasoline engines or flexible shafts. Applicable instructions for these types of power plants contained elsewhere in this manual will govern. Some timber saws operate with circular toothed blades, some with endless chains with cutting teeth, some with reciprocating saw blades.

4051. No part of the body should be permitted to come close to or contact a saw while it is running, except as necessary for its operation. No person should stand in front of a rotary saw while it is in operation.

4052. Men operating saws must see that their footing is secure at all times.

4053. Avoid wearing loose fitting clothing which may be caught in the chain or blade.

4054. Keep safety guards in place while saw is in operation.

4055. Saws powered by a gasoline engine should not be operated in a closed room.

4056. When moving a saw from one point to another, the motor must be stopped.

4057. Saw blades should be kept sharp.

4058. All saw teeth should be of uniform height, and the gullets of uniform depth. Teeth should be correctly and evenly set.

4059. Except to take an occasional burr from a tooth, no attempt should be made to sharpen cutting teeth in the field without a “jig”.

4060. Chain saws must be kept sharp and in proper adjustment.

4061. In sharpening chain saws, manufacturer’s instructions should be followed.

4062. Before making repairs or adjustments to the saw or chain:
   (a) Disconnect cable on electrically driven saws.
   (b) Disconnect air hose on pneumatically driven saws.
   (c) Stop the engine on gasoline-driven units.

4063. The saw blade or chain should be moved at full speed before it is applied to the work.

4064. Place the bumper against timber before starting cut with chain saw.

4065. An accumulation of sawdust at the cut should be avoided.

4066. The work should be properly supported at each side of the cut to prevent binding of the saw blade.

4067. A saw should not be forced to such an extent that it repeatedly stalls the engine or motor.

4068. If an electrically driven saw stalls, shut off the switch immediately.

4069. In cutting timber, it should be done in a manner to prevent the timber from falling and jamming the saw.

4070. When not in use or when being shipped, a saw should be kept in a specially constructed wooden box and the blade or tooth belt and guide coated with a liberal film of heavy oil.

4071. Avoid striking objects with end of chain saw while cutting, to prevent damage to saw and personal injury.

4072. Keep guide bar clean, remove sawdust and pitch.
4073. In cutting wood with high pitch content, remove chain, clean with kerosene or other approved cleaner, and soak in oil at end of day's work.

4074. Inspect electrical connections; see that equipment is properly grounded; if of the type which so requires, make tests in accordance with manufacturer's recommendations.
SNOWPLOWS - AUTOTRUCK
4080. Instructions on “Automobiles and Trucks” will apply.

SNOWPLOWS - BOXCAR
4090. Instructions for “Flangers (Boxcar-Type)” will apply.
SPike Pullers - Nordberg, Mechanical

5000. The entire machine should be checked frequently because of the shock to which these machines are subjected. It should be completely inspected and tightened once every week. It must be completely lubricated after every eight hours of operation. Oil should be changed in motor every 50 hours.

5001. Before starting engine, the belt-tightening pulley should be released. This is accomplished by lifting the belt-tightener pulley frame, allowing the belt-tightener frame support arm to lock in a vertical position to relieve the belt tension. This will eliminate the possibility of any damage should the engine backfire. After the engine is thoroughly warmed, engage the belt-tightening pulley by lifting the frame and tripping the support to permit the belt-tightening pulley to bring tension on the belt.

5002. The safety chains which limit the side movement of the spike tong bars must be securely fastened while the machine is in use.

5003. These safety chains must not be made longer or changed in any other way.

5004. Men operating the tongs should keep their arm stiff to minimize the chance of injury in case the tongs kick back.

5005. The size of block attached to the tongs must be in accordance with size prescribed to be used with height of rail on which the machine is working. The spike tongs, in pulling position with jaws engaged on the spike, should not allow more than 1" upward travel of the spike tong hook before contacting the spike tong lug or block. Maximum power is developed as the crank controlling the upward travel of the spike tong hook progresses just beyond bottom dead center. Therefore, take advantage to engage the tongs immediately after the hook begins its upward travel. Guard against allowing the spike tong hook to reach within one-half its upward travel before engaging the tongs. At this point a very heavy impact is produced due to the speed developed and will damage the frame and tongs.

5006. The spike tongs are supported by springs attached to the spike tong support and should be balanced to bring the jaws about 3/4" above the head of the spike. In so doing, it will utilize the suspension spring action for automatically closing the jaws when the tong has been pulled down to grip the spike. It is very important that tongs are kept well lubricated and tightened at all times.

5007. The support shoe must ride 3/4" above the rail. Adjustment can be made by either backing off, or by turning down the nuts compressing the axle-bearing springs. In spotting the spike puller, it is important that the toe of the support shoe extends beyond the spike to be pulled. This will prevent the rest of the machine from lifting from the rails and will concentrate the pulling reaction on the shoe and frame. The operator can relieve a good deal of strain from the tongs, providing he will work the tongs as near the vertical position as possible.

5008. When towing the machine, it is important that the front-end support shoe be removed in order that the machine will not be damaged by uneven rails at joints. Also, when towing, the split pin should be removed from the hub of spotting drive sprocket. This allows the sprocket to turn freely on the spotting sprocket shaft without turning the spotting operating wheel. Release belt-tightening pulley on belt, when not operating, and protect machine with a waterproof covering.

5009. The crankshaft is provided with three keyways, and when any appreciable wear occurs to the five or six teeth that absorb the shock on the crankshaft gear, it may be re-set in a new position. This will transfer the wear to new teeth and add to the service life of the gear.
5010. To compensate for the slack in the spotting-sprocket chain that may result from adjusting the axle-bearing springs, the spotting-sprocket bearing frame can be shimmed. This is accomplished by adding shims to the lower side of the frame.

5011. It is important that the crank capscrew be kept tight at all times.

SPIKE PULLERS - FAIRMONT, HYDRAULIC

5020. Instructions for Hydraulic Systems, paragraphs 270 through 289, and for Internal Combustion Engines, will apply.

5021. Before starting the engine, open the needle valve on the subplate below the accumulator.

5022. This needle valve must be closed while the machine is in operation and opened to release the pressure in the system at the close of the day's work.

5023. The strainer in the suction hose shall be cleaned daily by turning the “T” handle two complete turns clockwise.

5024. The reservoir of the hand control valve must be kept full of hydraulic oil, and the vented plug on this reservoir must not be replaced by a solid plug.

5025. The unloader valve on this machine is set for 3000 p.s.i., and under no conditions shall it be reset to exceed this pressure.

5026. The accumulator used in this hydraulic system is precharged with nitrogen to a pressure of 1500 p.s.i. at 70°F. Other types of gas must not be used.

5027. Repairs, adjustments, and the recharging of the accumulator must be done ONLY by persons qualified and authorized to do so.

5028. The priming gun used for the hand control valve, and the charging hose, and special fittings needed for the accumulator must be preserved and should be kept with the machine.
JORDAN SPREADERS

5050. Operators of Jordan Spreaders will be governed by the operating instructions posted under glass in the cab of the spreader.

5051. Before start of work the operator of the spreader will have a definite understanding with engineman and conductor as to what signals each may give to one of the others during the work.

5052. Diesel shifting locomotives of 1000 or more horsepower and equipped to furnish not less than 125 cubic feet of air at 100 pounds' pressure are required to properly operate a Jordan spreader.

5053. If locomotive to be used is equipped with special air line, connect the special air hose at the rear end of the car on left side to the air line leading to the main reservoir on the locomotive. Turn on the special angle cock handle. This will connect the main reservoir to the special air line on the car.

5054. If locomotive to be used is not equipped with special air line, the regular train line is to be used for supplying compressed air to the tank on the spreader. Train line pressure must be raised to at least 90 pounds pressure for successful operation. Cut out brake reservoir from train line when air to the air tank on the spreader is being supplied through the train line. Failure to do this will set the spreader brakes when the air is applied to operating cylinders.

5055. Whether the locomotive is or is not equipped with special air line, turn on the cutout valve at the air tank on the spreader. Air will then be conveyed from the locomotive into the air tank on the spreader and an air pressure gauge installed in the spreaded cab will be found registering the increasing pressure in the tank, which should be maintained at 90 to 100 pounds. The air reservoir or tank on the spreader is constructed for 100-pounds-per-square-inch working pressure.

5056. The conductor's air-brake valve for applying the train brakes is placed at a convenient location on the left wall of the spreader cab.

5057. All drains in the air lines and reservoirs must be opened occasionally during each tour of work, to allow the accumulation of water to drain off. This should be done frequently while spreader is being used in cold weather. At the close of each tour of work the drain cock in reservoir must be opened and left open until spreader is again required for work.

5058. The moving parts of a Jordan spreader are heavy and must be operated slowly at all times to prevent damage to the spreader and to the track in case of a derailment.

5059. Do not overload the spreader with too much spreading or ditching at one movement, especially when in heavy material.

5060. When it is necessary to work around or adjust the wings, braces or front plow while they are in the open or down position, first place them in the desired position, then allow the wings to go down until they rest on the ground, or block them securely so that there is no possible chance for them to drop or swing while men are around them. While working around the spreader never allow air in any cylinder supporting any part that might move.

5061. When spreader is being moved over the railroad, even for a short distance, the pins supporting the main wings and the front plow must be in place. Safety chains at the rear of the plow side wings must be pulled tight to prevent those parts from dropping.

5062. Main wings must rest securely in the hooks or wing rests located on sides of the spreader body, and diagonal braces must not be locked by the air-operated locking pins.
5063. Spreaders, when ditching, must not be operated at a speed of over five miles per hour.

5064. Spreaders must not be operated at a speed of over ten miles per hour when spreading dirt that has been removed from ditches and is known to be free from large or rigid obstructions, or when removing snow from yard tracks or sidings.

5065. Spreaders must not be operated at a speed of more than 15 miles per hour when spreading snow from main tracks where it is known there are no large or rigid obstructions.

5066. The following listed parts must be kept lubricated with Lift Bridge Sheave Grease, Material Catalog Reference No. 37-147, heated until it flows freely and then brushed or poured on:

(a) Moving parts of the front plow.
(b) Universal joints.
(c) Wing hinges.
(d) Cables and sheaves.

5067. DO NOT lubricate rear rack on telescopic braces.

5068. The following parts must be lubricated with Cup Grease No. 3, Material Catalog Reference No. 37-98:

(a) Sliding post carrying the main wing and diagonal braces.
(b) Inside of large pipe of telescopic braces.
(c) All end connections.

5069. The following parts must be lubricated with Medium Gas Engine Oil, Material Catalog Ref. No. 37-59:

(a) Piston rods.
(b) Air valves.
(c) Air cylinders, by pouring one-quarter (¼) pint of Engine Oil into air manifold and then blowing oil into each cylinder.

5070. Before spreaders are billed for shipment in revenue trains, the front-end plow must be raised to clear the top of the rail by five inches. This is accomplished by placing liners between center plates and by application of auxiliary side bearings.
SNOW SWEEPERS

5080. When a revolving rattan brush has been idle for several days, the hub and bristles become very dry, resulting in bristles breaking or falling out. Before operating the sweeper, the bristles and hub should be sprayed with water.

5081. Do not force the broom, too hard by too rapid traveling in heavy snow or dirt.

TRACK SWEEPERS

5090. "Diesel Powered Track Sweeper - Operation and Maintenance Instructions No. 65," issued by Chief Mechanical Officer, will govern.
TIE-BED SCARIFIERS

6000. Instructions for Hydraulic Systems, paragraphs 270 through 289, and for Internal Combustion Engines, will apply.

6001. The manufacturer's Lubrication Instructions must be adhered to.

6002. Before starting engine see that hydraulic reservoir is filled to proper level with the proper hydraulic oil as recommended by manufacturer.

CAUTION: Both gate valves, one on each side of reservoir, must be open.

6003. Vacuum gauge must show 10 to 18 inches of vacuum for proper operation of vacuum brake.

6004. Engine governor setting is 1900 r.p.m.

6005. Hydraulic system relief valve setting is 2000 p.s.i. maximum.

6006. Never move reversing valve lever while digging drums are revolving.

6007. Before traveling, digging drumhead and turntable must be in raised position and locked.

6008. Use low gear when digging and traveling a short distance. Use high gear for traveling to and from site of the work.

6009. When machine is to be towed, be sure transmission is in neutral position.

6010. This machine is equipped with a hydraulic hand pump for raising digging head or turntable in the event of engine or hydraulic power failure. It must be kept in good working condition at all times.
TIE HANDLER - NORDBERG GANDY

6020. Instructions for Internal Combustion Engines - General, paragraphs 60 to 87, will apply.

6021. For use as a crane:
(a) Adjust the boom to the proper angle and length to handle the load safely.
(b) When moving and carrying loads, lock the lower holding chain.
(c) Hold loads by locking winch brake.
(d) Apply holding chain to boom and lift material by wire rope winch.
(e) Apply rail clamps or add counterweight, if necessary.

6022. For use as a tie remover:
(a) Set boom in horizontal position and place in recess in frame of machine.
(b) Spot machine so that boom is directly over the tie.
(c) Apply boom chain to prevent boom from revolving.
(d) Insert wire rope through hollow mast and out under sheave.
(e) Extend outriggers, if necessary, and apply ties for counterweight.
(f) Attach tie tongs to end of tie.
(g) Apply brake on machine to prevent movement.
(h) Operate winch to remove tie.

6023. For use as a tie inserter:
(a) Shorten boom and set it at angle of approximately 45 degrees.
(b) Spot machine so that boom point is directly over place where tie is to be installed.
(c) Clamp boom chain to frame to keep boom from revolving.
(d) Place thrust member and wire rope sheave in position on machine frame, and place wire rope from boom tip around this sheave.
(e) Pull wire rope through sheaves and apply tie-inserting tongs over end of tie.
(f) Apply brake to machine to prevent movement.
(g) Operate winch to pull tie into position desired.
**TIE HANDLER - RAILWAY TRACK-WORK**

6025. Instructions for Internal Combustion Engines - General, paragraphs 60 to 87, and for Hydraulic Systems, paragraphs 270 to 289, will apply.

6026. Engine governor setting is 1800 r.p.m.

6027. Operator must see that hand brake is kept in good working condition and that it is applied when machine is parked.

6028. When towing this machine:
   (a) Jaw clutch on drive axle must be disconnected to prevent damage to propelling motor.
   (b) Boom must be carried over a push car to prevent accident in case boom should fall while machine is in motion.

**TIE REMOVER - FAIRMONT**

6030. Instructions for Internal Combustion Engines - General, paragraphs 60 to 87, and for Hydraulic Systems, paragraphs 270 to 289, will apply.

6031. Engine governor setting is 1800 r.p.m.

6032. Before starting the engine:
   (a) See that reservoir is filled to proper level with recommended hydraulic oil. Do not use hydraulic brake fluid.
   (b) Set rail clamps for height of rail.
   (c) Adjust rail hook chains to proper length for rail size.
   (d) Check shoe teeth to see that they are sharp.

6033. Before removing tie:
   (a) Remove spikes, tie plates and interfering rail anchors.
   (b) If ballast section is full, lower ballast under rails adjacent to tie being removed to permit engagement of rail clamps and chain hooks.
   (c) When badly plate-cut ties are being removed without a raise, high section of tie on operator's side of rails should be removed.

6034. Tie removal:
   (a) When engaging shoe teeth, if possible avoid splits and checks.
   (b) Never make first stroke with teeth engaged more than 10 inches from far rail.
   (c) The last push is made with end of ram against end of tie, being careful that ram shaft does not scrape rail base and actuate signals. Shoe casting is insulated and will not operate signals when contacting rail.

6035. Moving machine on track:
   (a) Be sure rail clamps and chain hooks are released before lowering rail wheels to raise machine.
   (b) To save time, do not raise machine more than necessary.
   (c) Do not hang chain hook assemblies over ram, as doing so will damage the boot.

6036. When setting off track:
   (a) Raise machine as high as possible on rail wheels.
   (b) Lower and lock pneumatic setoff wheels.
   (c) Retract rail wheels.
   (d) Slide engine and reservoir unit toward outside of rail.

6037. Keep engine at idle speed when not actually at work.
6038. Do not tamper with relief valves except on proper authority.

**TIE INSERTER - FAIRMONT TIE HANDLER**

6040. Instructions for Internal Combustion Engines - General, paragraphs 60 to 87, and for Hydraulic Systems, paragraphs 270 to 289, will apply.

6041. Engine governor setting is 1800 r.p.m.

6042. Before starting the engine:
   (a) See that reservoir is filled to proper level with recommended hydraulic oil. Do not use hydraulic brake fluid.
   (b) Be sure winch cable is in good condition.

6043. When operating winch, keep slack out of cable so it feeds evenly onto drum.

6044. Be sure cable winds onto or unwinds from bottom or lower part of drum.

6045. Move through switches or frogs at slow speed.

6046. Disengage propelling motor clutch when towing the machine.

6047. Lock the adjustable brace in the raised position when deadheading or setting off.

6048. When setting off track:
   (a) Lower and lock pneumatic setoff wheels.
   (b) Unlock third wheel clamp which allows wheel to swivel.
TIE NIPPERS AND SPIKERS

All Types

6050. Instructions for Internal Combustion Engines - General, for Air Compressors, for Penumatic Tools, and for Hydraulic Systems will apply.

R.M.C. Spike Master

6051. Line lubricators must be filled at all times with pneumatic tool oil, Acct. 37, Ref. 388, before starting machine.

6052. The drive chain from transmission to rear or drive axle must be kept tight at all times.

6053. Pneumatic spike hammers must be so set as to be centered over spikes to be driven before starting operation, and adjustments made for size of rail to allow hammers to fully drive the spikes.

6054. When operating the tie nippers, tongs must be centered over the tie to be nipped and spiked.

6055. Operator must retract tie nippers tongs before starting propelling gear to move the machine.

6056. Be sure transmission is in neutral position before towing this machine.
6070. Instructions for Internal Combustion Engines General, for Hydraulic Systems and for Autotucks, contained elsewhere in this manual, will apply.

6071. The operator shall make frequent observation of the conveyor belts while the machine is in operation, to prevent damage due to:

(a) The type of materials being deposited upon them.
(b) Rubbing on the skirt boards or upon the side of the car in which material is being loaded.
(c) The belts not running true on the pulleys or guides.
(d) Overloading.

6072. The operator of this machine shall keep the scraper body in proper adjustment to insure that there is clearance for the main conveyor belt and the cleats upon it.

6073. The operator shall keep the overload clutch, feeder and conveyor drive clutch and the feeder chain in proper adjustment, to prevent damage to the machine.

6074. When working in hydraulic drive, the governor spring will be detached to permit the engine to run at the proper speed.

6075. The feeder chain is in proper adjustment when there is approximately 2 inches of vertical movement midway between the sprockets with a chain pin centered on the return roller.

6076. The operator of this machine must keep the throttle wide open to maintain the engine speed between 1600 and 1800 r.p.m. while working in hydraulic drive, to prevent damage to fluid coupling.

6077. When material is being loaded with the scraper body between the rails, the operator shall keep the machine centered so that the side walls of the tires will not be damaged by rubbing upon the rail.

6078. This machine should not be used to pull cars into which material is being loaded.

6079. The operator is responsible for proper protection of the machine against damage due to switching or train movements, and when working on tracks where traffic has been temporarily discontinued, must, for the protection of the machine, keep all of the machine within the protected area or arrange for additional protection.

6080. When traveling over the rails with this machine, the operator shall use such blocking as may be necessary to prevent damage to the machine.

6081. This machine shall not be operated with less than 35 pounds, nor more than 50 pounds, of air pressure in the tires.

6082. When traveling in mechanical drive, the operator must make sure that:

(a) The hydraulic brakes and the hand-operated emergency brake are in good condition.
(b) The safety strap is applied to prevent the bucket boom from vertical movement.
(c) The wire rope which supports the scraper body is in good condition and securely fastened.
(d) The swivel conveyor is locked to prevent it from swinging.
7000. Operating Speed of Engine is 2680 r.p.m. Hydraulic Pressure at Pump is 2000 p.s.i. and at Relief Valve is 1900 p.s.i. Instructions for Internal Combustion Engines - General and for Hydraulic Systems will apply.

7001. In preparing machine for use:
(a) Determine the exact distance necessary, from the base of one rail to the base of the opposite rail, to provide the desired gauge of the track.
(b) Set the gauger on the track with the elongated gauging shoe on the side where the rail is to be laid.
(c) Measure the distance between the shoulders on a tie plate to be used and adjust the width of the shoe to provide a snug sliding fit.
(d) Adjust the drill-bit spindle spacing to fit the holes in the tie plate.
(e) Set the machine on tie plates laid and pregauged on the ties where the rail has been removed.
(f) Adjust the tapered rollers which rest upon the rail left in track, as necessary, to provide the measurement determined in subparagraph (a) above.

7002. Gauge adjustments may be necessary when the machine is changed from one rail to the other.

7003. Gauge adjustment is necessary for each type and weight of rail.

7004. A frequent check of the desired measurement should be made after each readjustment and during operation to insure proper track gauge.

7005. Care should be exercised to prevent damage to the tapered shank on the drill adapters and to the tapered socket into which it fits.

7006. Tapered shank on the adapter and the tapered socket in the drill spindle must be kept clean.

7007. The tapered shank on the adapter must fit snugly into the tapered socket in the drill spindle.

7008. Drill bits should be tightened securely in the adapter chuck.

7009. The over-all length of the adapter and the drill should be determined and set by use of a gauge.

7010. Dull bits should not be used.

7011. Operator of the machine must exercise care to minimize the breaking and dulling of bits by striking the tie plate.

7012. Travel speed of the machine should be governed by the number of ties, usually every fourth or fifth, to be drilled in each rail length, and the actual drilling time.

7013. Drill bits must be raised high enough to clear the tie plate before the roller-mounted frame which supports them has reached the stops at the end of its travel.

7014. The feeding pressure on the drill should be constant, but excessive pressure should be avoided.

7015. When setting it off the track, select a location where dirt, cinders, and other foreign material will not be forced into the rollers and guides.

7016. Care must be exercised in handling the machine to prevent damage to the tapered rollers and the gauging shoe assembly.
TRACK LINING MACHINES

7020. Instructions for Internal Combustion Engines - General and Hydraulic Systems apply to all makes of these machines.

Nordberg Track Liner

7021. Engine governor setting is 2600 r.p.m. Hydraulic pressures are: Pump - 6000 p.s.i. maximum; Adjustable Relief Valve - 0 to 5000 p.s.i.

7022. The operator of this machine shall be governed by the following:
   (a) Place removable flanges on the wheels opposite the side from which the employee will observe the lining operation.
   (b) Slide the flange of the wheel on the observation side against the machine frame and lock it in position.
   (c) Spot the machine where the lifting bars will seat themselves under the ball of the rail with no interference from angle bars or butt-welded joints.
   (d) Place the lifting spuds at right angle to the rail, between the ties, and keep the lifting ram perpendicular and parallel to the ends of the machine.
   (c) Place the lifting-ram travel stops in position on the lifting shoes.

7023. The operator and others concerned shall observe the following when traveling to and from work with this machine:
   (a) Remove the outside flange that was applied for the lining operation.
   (b) Replace the sliding flange on the inside of the opposite wheels and see that all of the sliding inside flanges are locked in position.
   (c) Remove the lifting-ram travel stops, raise the shoes to the top position, and lock them.
   (d) Raise the lifting bars to the top position, insert the lock pin to prevent the ram piston from moving; also apply safety chains to prevent lifting bars from dropping in case of failure of the wire rope which supports them.

7024. The operator and others who ride upon the platforms of this machine must be on the alert at all times to prevent personal injury due to a sudden stop.

7025. Track tools, material, and supplies should not be carried on this machine.

7026. The operator of this machine shall keep the lifting bars at the ends of the unit properly centered and evenly adjusted.

7027. The lifting bars are in proper adjustment when they are supported by the adjusting bolts and there is approximately one-eighth (1/8) of an inch space between the top of the lifting bar and the bottom of the ball of the rail.

7028. The operator shall keep the adjusting bolt lock nuts securely tightened except when making adjustments to the lifting bar.

7029. The operator must make adjustments to the relief valve which governs the hydraulic pressure on the lifting rams, and shall use the minimum pressure and lift required to shift the track.

7030. The operator should not attempt to control the pressure on the lifting rams by manipulating the control valve.

7031. The operator shall make sure that there is nothing to prevent the free movement of the lifting bars in the guide frame.
Railway Maintenance Corporation Linemaster

7040. Engine governor setting is 2150 r.p.m. Recommended speed for Hydraulic Pumps is 1670 r.p.m. and for Spud is 70 r.p.m. Hydraulic Pump pressure should be 2000 p.s.i. minimum and 2100 p.s.i. maximum.

7041. Before starting the engine:
(a) See that the reservoir is filled to proper level with the recommended hydraulic oil.
(b) Disengage the clutch and see that controls are in proper position.

7042. Before moving the machine:
(a) Operate the hydraulic pumps slowly for a few minutes to insure adequate circulation of oil.
(b) Raise the center lifting cylinder to its top position.
(c) Raise the lining head.
(d) Raise the spud.
(e) Move the spud to the vertical position.
(f) Retract both lining dogs.

7043. Filters should be cleaned at regular intervals.

7044. To line track with this machine:
(a) Lower the rail clamp and machine holding ram.
(b) Lower the lining head so that the weight of the machine will hold it in position.
(c) Retract wheels on the side the sighting is to be done.
(d) Rotate the spud and lower it into the ballast a sufficient distance for secure anchorage.
(e) Tilt the spud toward the rail on the side in the direction of throw.
(f) Actuate the lining ram to move the track.

7045. Adjust head guide roller pins as necessary to keep the head in proper position in the slides.

7046. Keep machine properly lubricated in accordance with the manufacturer's recommendations.

7047. Before towing this machine, be sure transmission is in neutral to avoid damage to travel motor.

7048. Drop the lining head when leaving the machine unattended.

Railway Track-work Company Model PO and POA

7050. Engine governor setting is 2700 r.p.m. Hydraulic pressure is 1800 p.s.i.

7051. Before starting engine:
(a) See that hydraulic reservoir is filled to proper level with recommended hydraulic oil.
(b) See that all controls are in neutral and all hose connections are in proper place and secure.

7052. To line track:
(a) Lock rail clamps in position.
(b) Tilt the ram toward the rail on the side in the direction of throw.
(c) Operate ram until foot is firmly seated in ballast.
(d) Then operate ram in a series of short thrusts until track is properly positioned. By moving track in short thrusts, there will be less tendency to hump the track than if a prolonged or continued thrust is used.
TRACK SHIFTERS

7070. This machine is subject to heavy shock and must be inspected frequently each day and all loose bolts tightened.

7071. To start machine, set hand brake; engine clutch should be free. Advance throttle slightly by turning down (counterclockwise) lever mounted on right-hand side of handrail. Allow engine to warm up before commencing operation. Disengage the clutch shift lever, and gear shift lever should be in neutral position when engine clutch is "thrown in".

7072. When traveling, be sure that spud shoe and rail clamps are up to clear rails. Release hand brake; move clutch shift lever toward the right (car drive position); throw gear shift lever toward right (traveling low position). Accelerate engine slightly and slowly depress clutch foot pedal and hold it there (depressing left-hand clutch pedal moves car forward and right-hand clutch reverses car). When car has gained momentum and high speed is desired, release foot clutch pedal; throw gear shift lever toward left (traveling high position); quickly depress foot clutch pedal. For slow stops or checking speed, foot brake can be used; for quick stops, use hand brake.

7073. For spotting car and clamping to rail, spot car so that spud can be lowered between ties, avoiding joint bars. Set hand brakes; release clamping lever by kicking out latch; release both clamp levers; then bring outside or clamping lever alone into latch position. Make sure that all four clamps are hooked to rail. Move spud carriage to desired position by working traverse lever arm back and forth, setting the traverse pawl for the direction in which spud carriage is to be moved.

7074. For shifting track, carriage should be spotted as far in the direction of the shift as possible. Allowance should be made so that spud shoe does not strike the base of the rail when the desired starting angle of tilt has been given to the spud by the hand wheel.

7075. Lowering Spud - Throw gear shift lever toward left and clutch shift lever toward left; step on clutch pedal - (L. H. pedal depressed moves spud down - R. H. pedal depressed moves spud up). Open throttle wide; let the engine governor control engine speed (guide tilt of spud by hand wheel); release foot pedal when maximum throw has been obtained. If there is an exceptionally high lift, release foot pedal and throw gear shift lever toward right. This puts it into low.

7076. Recovering - With clutch shift lever toward left, depress pedal, bringing spud up. Bring spud up to clear track; release clamping lever; throw clutch shift lever toward right and depress either R. H. or L. H. clutch pedal. Latch clamp lifter lever only for short moves. Bring both clamp levers into latch for safety position.
TRACTORS - CRAWLER-MOUNTED

7100. Maximum permissible speed on metal crawler is about 3½ miles per hour.

7101. Lubricating procedure should be in accordance with manufacturer's instructions.

7102. Before starting the engine:
   (a) Inspect the tracks, idlers, sprockets, rollers, and other parts of the machine and attachments to ensure that all moving parts are free.
   (b) Be sure that the gear shift lever and other controls which affect the movement of the machine or its attachments are in neutral position.

7103. When filling radiator in freezing weather, close winter-front shutter completely. Start engine - then put in water immediately. This prevents water from freezing during warming-up period. Thermostat in cooling system prevents water from circulating through radiator until engine is warm.

7104. When engine is operating, adjust winter-front shutter to maintain operating temperature of engine.

7105. Before moving this machine in freezing weather, check tracks to see if they are frozen to the ground, and if they are they must be broken loose before tractor is put in gear.

7106. When starting the tractor always engage the clutch gradually so engine will pick up the load slowly. This is necessary when going up a steep hill, climbing out of ditches, or when hitched to a heavy load. Never hitch to a stump or other object by means of a long chain or rope with slack so that when tractor moves forward it will jerk into the load.

7107. The pointer in oil pressure indicator (unless defective) should register at all times when the engine is running. Should the indicator not register, it is an indication that the oil circulating system is not performing properly or the oil supply needs renewing. The engine should be stopped immediately and the oil system inspected to find the cause of failure.

7108. It is necessary that the oil filter be cleaned daily, as follows:
   (a) Stop engine.
   (b) Remove drain plug which will allow the oil filter to drain, then replace drain plug tight.
   (c) Unscrew and remove retaining bar.
   (d) Lift up and remove outer shell.
   (e) The filter element can now be removed.
   (f) In some cases where clearance is small, it may be necessary to lift the outer shell and filter element together in order to remove.
   (g) Wash filter element in clean kerosene, using soft brush or cloth.
   (h) Inspect the filter and if there are any breaks, it should be renewed.
   (i) Clean and flush out the base with kerosene, being careful not to let the kerosene enter the oil inlet or the oil outlet openings.
   (j) See that the case gasket is in position, then replace the drain plug, filter case, retaining nut, and draw the nut up tight.
   (k) Start the engine, inspect the filter for oil leaks and check the oil level in crankcase.

7109. The air intake pipe is provided with an inlet screen to prevent large particles, such as chaff, leaves, etc., from entering the air cleaner.

7110. Keep this inlet screen clean. The holes must be
kept open and free of paint, as enough dust, oil or water may collect on the screen to clog up the holes enough to restrict the flow of air to the engine, thereby interfering with the cleaning action of the air cleaner. Restricted air flow will also cut down on the horsepower delivered by the engine.

7111. The air intake pipe from inlet screen to the air cleaner should not be allowed to collect dirt on the inside. Remove and clean this pipe when air cleaner is removed; at the same time, clean inlet tube through air cleaner and inlet passage through the top casting.

7112. The complete air cleaner must be removed and the inside washed thoroughly at intervals frequent enough to insure clean screens in the cleaner. This may be necessary after every fifty hours of operation if operating in an atmosphere heavily laden with dust.

7113. Failure to keep the cleaner properly serviced will result in the loss of power and cause excess fuel consumption and incidentally poor operation.

7114. Remove the nuts or cap screws at top of cleaner. Be careful not to injure the gasket when separating from top casting. Remove oil cup, also the bottom plate held in place by screws. Scrape and clean out all dirt in center inlet tube; partially fill cleaner with kerosene, stop up both ends of cleaner and shake thoroughly until all dirt is removed. (The cleaner can also be cleaned by shaking it in a container of kerosene.) Replace bottom plate and top gasket in the same position. Make sure gaskets are in place, clean, flat and in good condition. Check top casting bolts or nuts to see that they are tight. Replace oil cup after filling to proper level with specified oil.

7115. To prevent the entrance of dirt into the engine, it is absolutely essential that frequent inspections be made of flexible connections to the carburetor and air cleaner, hose and hose clamps when used. Flexible connections should be replaced before they deteriorate. To eliminate any undue strain on the connections, make sure pipe is in line. See that all joints between the air cleaner and the cylinders of the engine are tight; this includes flexible or hose couplings, carburetor and manifold joints and gaskets. All gaskets must be in good condition and bolts drawn up tight.

7116. Tracks should be kept in proper adjustment in accordance with manufacturer's recommendations. When track adjustment is either too tight or too loose it causes undue wear on track links, pins, bushings and bearings.

7117. Bolts and nuts which hold track shoes or grousers should be kept tight.

7118. The track chain spring, when properly adjusted, takes care of the play in the track chain, so that there is no looseness or tension on track when in normal operating position. A track chain is properly adjusted when it sags 1/2" to 1 1/2" between front idler and driving sprocket.

7119. Where tracks show evidence of being stiff or tight, indicated by links in the track remaining kinked as they travel along top section, they may often be made to work much more freely by being cleaned thoroughly with an application of kerosene or fuel oil. The use of lubricant is not ordinarily recommended for tracks, except for temporarily freeing them after they have become tight between the pins and bushings for any cause.

7120. Operators shall keep the brakes and steering clutches in proper adjustment at all times.

7121. The brake pedals shall not be used as a foot rest while machines are in motion.

7122. The operator shall engage clutch and apply brakes in such manner that undue strain will not be placed upon the propelling mechanism.
7123. If tractor is operating in deep water or thawing snow, lubricate track roller every five hours. This will flush out water that might be forced past seals into lubricant. If operating in water of a depth that bottom of transmission case is submerged, inspect transmission lubricant in transmission case and drive gear sprocket cases frequently. If any water is present, drain and refill with new oil.

7124. When descending steep grades:
(a) Keep throttle in idling position.
(b) Keep tractor in gear.
(c) Avoid sharp, sudden turns.

7125. Short turns shall not be made if possible to avoid them. When necessary, they must be made at low speed.

7126. The employee assigned to operate this equipment shall keep it as clean as is consistent with the work being performed, and will inspect and clean it as often as necessary to insure that moving parts are free.

7127. Operators must not inspect or perform work on bulldozer blade or other attachments while supported only by wire rope or hydraulic oil pressure. When necessary to inspect or perform work on this equipment, and it cannot be done with accessories resting on the ground, such accessory shall be properly blocked to prevent personal injury.

TRACTORS - WHEEL-MOUNTED

7150. All applicable instructions for Automobiles - Autotrucks - Auto Trailers will govern.
AUTOMOBILES -- AUTOTRUCKS --
AUTO TRAILERS

7200. Drivers or Operators must be qualified, and where required, licensed under the laws of States in which they operate.

7201. All traffic rules and regulations must be adhered to -- stops must be made at all railway grade crossings, and drivers make sure it is safe to proceed.

7202. Inspection, maintenance, and operation of automobiles, autotrucks, etc., will be in accordance with Letter of General Practice No. 248.

7203. Trucks must be stenciled, in \( \frac{3}{4} \)" letters, inside cab over windshield, indicating information similar to the following:

\[
\begin{array}{c}
\text{Truck - Lightweight} \quad 00,000 \quad \text{pounds} \\
\text{Maximum Pay Load} \quad 00,000 \quad \text{pounds}
\end{array}
\]

The trucks must also be stenciled, in 1" numerals, on fender or body above each wheel, to show the proper tire inflation.

7204. This equipment, having pneumatic tires, must not be operated with tire air pressure more than 20% below that recommended by manufacturers.

7205. Trucks must not be loaded beyond rated capacity.

7206. Spare tires must be rotated in service at least every three months.
TRENCHING MACHINES

Crawler-Mounted (Barber-Greene Model 44)

7300. Instructions for Tractors-Crawler and Cranes, where applicable, will govern.

7301. The width of the ditch may be changed from 18" to 24" by:
(a) Remove teeth on outer edges of buckets.
(b) Apply extensions to buckets.
(c) Bolt outside teeth to extensions.
(d) For average digging, placing extensions on every other bucket will suffice.

7302. The width of the ditch may be changed from 18" to 24" by:
(a) Remove teeth on outer edges of buckets.
(b) Apply extensions to buckets.
(c) Bolt outside teeth to extensions.
(d) For average digging, placing extensions on every other bucket will suffice.

7303. The discharge conveyor belt shall be properly adjusted to keep it running true on the roller.

Pneumatic-Tired (Barber-Greene Model 702)

7310. Bucket line speed is controlled by the main transmission, and the following should be used as a guide. See that governor control rod is in the correct position, and:
(a) Put transmission in low when digging in rocky soils.
(b) Use second gear for normal soils.
(c) Use third gear for cleaning buckets and for work in sandy or muddy soils.
(d) Use reverse gear only for cleaning the bucket line.
(e) Fourth speed (high) and reverse must not be used for digging.

7311. Do not raise crowd lever to its uppermost position except as necessary to back away from obstructions.

7312. Adjust speed-control valve as necessary to reduce overloading of bucket and strain on power plant.

7313. Operator should remain within reach of crowd lever and speed-control valve.

7314. When traveling:
(a) Raise digging boom to uppermost position.
(b) Avoid excessive speed. High speed over rough terrain will damage machine, as it is not spring-mounted.

7315. This machine should not be used to dig on a side slope with angle of incline greater than 8 to 10 degrees.

7316. Keep conveyor belts in proper adjustment to prevent damage by slipping or being out of line.

7317. Keep drive chains and sprockets in proper alignment and adjustment.

7318. Use the following as a guide for chain tension:
(a) Shafts with 3-ft. centers, allow ½" slack.
(b) Shafts on 6-ft. centers, allow 1" slack.

7319. Adjustment to overload-release sprocket should be made only by persons qualified and authorized to do so.

7320. In making adjustment, overload-release springs must not be completely compressed.

7321. Dull bucket teeth should not be used.

7322. Replace teeth when they become dull or broken.

7323. Installation of a few new teeth on bucket line intermingled with worn or broken teeth is not recommended. Complete renewal should be made.

7324. Bucket line is in proper adjustment when not more than 2 or 3 inches of sag develops when boom is raised.

7325. The machine must not be towed, even for short distances, until the towing lock pin is in position and properly secured.
7326. When towing:
(a) Raise the swivel wheel assembly to uppermost position.
(b) Attach safety chains from the machines to the towing vehicle.
(c) Do not exceed 25 m.p.h. with machine equipped with single drive-wheel tire, or 45 m.p.h. with machines equipped with dual tires on drive wheels.
WEED BURNERS

7400. Every precaution to control the fires must be taken. Careful inspection must be made at every opportunity for leaks in either oil or gasoline systems. These inspections must be made at least every four hours and the Machine Operator must observe as much of the oil and gasoline system as is visible, at frequent intervals during operation.

7401. Suitable fire extinguishers must be available and ready for instant use. The operator must know that the fire extinguishers are ready for use before starting the fires on the burner.

7402. Care must be exercised in handling all fuel and lubricants to avoid spilling and creating fire hazards.

7403. When the burners are lighted, the machine must never be operated at less than three miles per hour. Operating at slower speeds will destroy the burner heads. It may also permit too much heat on the adjacent axle and bearings, drying out the lubricant and expanding the axle beyond the allowed lateral clearance.

7404. If necessary to operate it when the heat is being blown directly toward the machine, make inspection as frequently as necessary to minimize fire hazards.

7405. It is extremely important to keep the fuel oil clean, as minute particles of foreign matter will obstruct the atomizers, necessitating costly stops to clean them. The strainers in the fuel lines should be cleaned once each week, or oftener if conditions require.

7406. Rubber hose must not be used for transferring fuel, as the rubber disintegrates and obstructs the fuel strainers, or atomizers if the strainers are defective.

7407. Before starting the engine for operating oil pump and blower, the operator shall make sure that there is fuel oil in the pump.

7408. Care must be exercised in lighting the burners, to avoid personal injury and damage to property by fire.

7409. If the automatic igniting device is inoperative, the long handle torch furnished with the burner shall be used to light the burners.

7410. The burner is not properly ignited and shall not be used when oil continues to run out of the head after the fire is burning. Shut it off, correct the condition, and relight it.

7411. The nozzles in these burners are designed to operate at a predetermined pressure and shall not be operated with less than the manufacturer's recommended pressure on the fuel-oil pump.

7412. Check the fuel pressure frequently, and if unable to maintain the pressure, one or more of the following may be causing the condition:

(a) Air leak in the suction line to pump.
(b) An obstruction in the fuel-oil line.
(c) Belts on fuel-oil pump broken or too loose.
(d) A broken regulator valve.
(e) A loose cap on the burner nozzle.
(f) Defective fuel-oil pump.

7413. Water should never be thrown on the burner heads to cool them.

7414. The weed burner crew must observe the operation of the extinguisher cars, so that when necessary they can stop and assist in extinguishing fires.

7415. The weed burner crew must know that their motor cars and extinguisher cars are in dependable, serviceable condition each morning before starting to burn.
WEED SPRAY CARS

7450. "Instructions for Operation of Weed Spray Cars" and "Instructions to Protect Weed Spray Cars When Not in Use", issued by Chief Mechanical Officer, apply.

7451. A 2-inch globe valve must be applied to bottom outlet of tank cars containing chlorate weed killer. This valve must be closed before tank valve is opened.

7452. Extreme care must be exercised in opening the tank valve and attaching the hose to the outlet on tank cars. This, to avoid wastage and damage that might otherwise result.

7453. Chlorate weed killers contain large quantities of oxygen, which supports combustion. Clothing, wood or other organic matter saturated with chlorate weed killer will ignite readily and burn rapidly.

7454. Weed spray must be shut off in passing over wooden structures or wooden deck bridges.

7455. Care must be taken to avoid saturating timber structures, station platform, etc. with weed killer sprays.

7456. A supply of sand should be carried on weed spray cars, to extinguish any fires which might develop on the cars.

7457. Promptly, after close of spraying season, or when use of car has been discontinued for an indefinite time, it must be protected in accordance with instructions issued by the Chief Mechanical Officer.
WRENCHES - POWER

Gasoline-Engine-Driven Wrenches - General

8500. Machine to be used in bolt-tightening must be in satisfactory operating condition, and prior to making adjustments for specified bolt tensions or in normal work the machine with chuck in gear must be run for at least 10 minutes until thoroughly heated.

8501. Adjustments of machine for specified bolt tensions must be made by use of approved design of calibrated tension meter now available for general use.

8502. In adjusting wrenches for bolt tensions the tension meter shall be temporarily fastened to a rail, and the bolts used in the tension meter must be selected at random from the same bolts to be applied or tightened on each specific job.

8503. Bolts used in tension meter must not be used for more than one tightening, as damaged threads or generated heat from thread friction will produce inaccurate tension setting of the wrench.

8504. Bolts used in tension meter must be free from dirt, cinders, or other foreign substance and care exercised to apply bolts in tension meter so that full and uniform bearing of the bolt head is obtained and the shank and thread portions of the bolt do not contact any part of the tension meter.

8505. Tension adjustments of the wrench must be checked frequently; preferably immediately before actual work of tightening is started.

8506. Bolts in joint bars must have full and uniform seating of bolt heads against sides of joint bars, sledger bolts when necessary to obtain correct seating before applying wrench to nut.

8507. In applying nuts to bolts on new work it is frequently necessary to hold the bolt in the oval hole of joint bar to prevent turning. This can be done by placing toe of shoe against bolt head while engaging chuck to the nut.

8508. Before proceeding with work of applying or tightening bolts the Machine Operator must obtain from the Track Supervisor for each specific assignment the amount of bolt tension to be applied to the bolts, as specified in C. E. 78.

8509. Chucks must be revolving when applied to nuts for either tightening or loosening.

8510. When chuck is applied to nut, the center line of chuck must be on center line of bolt, to avoid violent lateral strains in the machine and possible damage to gear train.

Raco - Model A

8511. Before changing spring tension, loosen the winged check nut

8512. To engage power, the operating clutch lever must be pressed down and held firmly. Repeated jabbing down of operating lever to start "frozen" nut or for any other purpose is prohibited.

8513. To release power, lift the operating clutch lever with a quickly applied motion.

8514. When power bolt tension is obtained, as indicated by the stopping of chucks, power must be released immediately.

8515. Machine must not be used on rail thrown out of gauge and to one side unless provision is made for outboard axle to be properly supported and the machine made level.

8516. When engine is cold, cranking will be easier if vertical dynamometer shaft is pulled out, taking the load off the engine.

8517. HIGH and LOW refer to the speed of chucks. HIGH SPEED chuck is on the short end of chuck housing
(Speed 60 r.p.m.). LOW SPEED chuck is on long end of chuck housing (Speed 14 r.p.m.).

8518. For applying or removing nuts in rail-laying operations, use HIGH SPEED chuck. If bolts are rusted, start with LOW SPEED chuck and finish with HIGH SPEED chuck.

8519. When tightening old bolts, low speed chuck is to be used with dynamometer arm in low torque position.

8520. For removing nuts, use spring tension at 30. If additional torque is needed, increase spring tension to limit required.

8521. Pressing in on the dynamometer arm for purpose of overloading the machine is prohibited.

8522. Thrust Bearing, part 313, must be kept lubricated through grease fitting in Dynamometer Shaft Housing Cover, part 320, using Heavy Engine Oil, S.A.E. 50 Material Catalog Reference No. 37-60.

Raco - Model C

8525. Engine speed should be 2900 r.p.m. Nut chuck, high speed - 112 r.p.m.; low speed - 26 r.p.m.

8526. Operating lever acts through a “Z” plate, somewhat the same as on an automobile shift lever -
Top slot for low speed.
Bottom slot for high speed.
Halfway notch for neutral.
When nut has been tightened (at either high or low speed), return operating lever immediately to neutral notch.

8527. Reverse lever (No. 492) must be used only when machine is not under load.

8528. Power booster lever is at back of operating head and may be used for applying full engine power to chucks (for example, when stripping) when they are operating at either high or low speed.

8529. The micro cutout is a clutch device combined with a positive reactive release for applying definite torque to nuts, and the proper setting of the micro cutout is to be determined by using tension meter, Par. 8501.

8530. To maintain full clutch engagement, or to secure this condition when for any reason clutch rod, part 457, is removed, the following adjustments must be made:
With engine running, adjust length of clutch rod, part 457, at operating head end so that chucks just start to revolve when gear shift lever, part 480, is equidistant out of neutral position either to the high or low speed position.

8531. Check adjustment of the power booster lever at regular intervals, as follows:
(a) Place machine in low gear.
(b) Push lever down to within 1½ inches of its lowest position. If further depression of lever causes chucks to stop, lever is in proper adjustment.
(c) When chucks rotate with lever in its lowest position, shorten the adjusting rod.
(d) When chucks stop rotating before lever reaches point 1½ inches of its lowest position, lengthen the adjusting rod.
(e) Make adjustment of the rod at the operating-head end.

8532. Add lubricant 600W or S.A.E. 140, Material Catalog Reference No. 37-233, to the main housing as necessary to keep filled to level of check-plug opening on end of housing.
8533. Do not lift this machine by the clutch rod (this is the highest rod on the machine), since the bending of this rod will throw the clutches out of adjustment. Use lifting hook provided for this purpose.

Nordberg - Model CW

8535. When equipped with a Model ZH, Briggs & Stratton engine, and operated at 2500 r.p.m., the driving chucks operate at 72 r.p.m.

8536. There is no high and low speed on this unit.

8537. When necessary to make available the full power of the engine for removal of "frozen" or rusted nuts or tightening bolts, depress the operating lever to lock the overload release.

8538. NEVER ATTEMPT TO LOCK THE OVERLOAD RELEASE WHILE THE DRIVING CHUCK IS ON THE NUT.

8539. Disengage the clutch at the first click of the release when overload release is used, in order to reduce damage to the machine.

8540. Replace overload release rubber bumper when necessary. (A supply should be kept with the machine.)

8541. Oil and grease must not be allowed to accumulate on the rubber.

8542. A slight film of grease must be applied to the overload release gear. This gear must be cleaned and the grease renewed once each week, or oftener if evidence of dirt or grit exists before the expiration of one week. Do not over-grease, as a slight film is satisfactory.

8543. The roller chain must not be lubricated. Once each month remove the roller chain, clean and soak overnight in Light Gas Engine Oil, S.A.E. 20, Material Catalog Ref. No. 37-56; wipe off thoroughly before replacing on the machine.

8544. Provision is made to take up any slack in the chain, as it occurs, by means of shims which can be inserted where the wrench arm is attached to the machine.

8545. The shaft driving the chucks is recessed to provide a path for the roller supports just inside the shaft housing at both ends. These recesses must be cleaned and packed with grease daily, and every precaution taken to prevent dirt from entering this location.

8546. The grease should be tested between thumb and finger several times daily to be sure that dirt has not entered the grease.

8547. ATTENTION! GUARD AGAINST EXCESSIVE RELEASING, AS THIS WILL THROW AN UNDUE STRAIN ON THE MACHINE.

8548. The Model "CW", equipped with Model ZZ1 Briggs & Stratton engine, must not be operated with engine speed greater than 2750 r.p.m., or chuck speed in excess of 80 r.p.m., when equipped with 8-tooth sprocket, or 90 r.p.m. when equipped with 7-tooth sprocket.

8549. Grease must not be allowed to accumulate on the aluminum bevel frictions or on the face of the fibre cone on the engine shaft. In case the faces of the aluminum bevel frictions become coated, they can be cleaned with gasoline.

8550. Other than applying grease in cups provided to the double-flanged rollers and turntable, no additional lubrication is necessary in that the bearings are sealed and packed with grease ready for one year of operation. At the end of this allotted time, or during periodic overhauls, the machine when dismantled is repacked with grease and again assembled for use.
8551. All sockets are provided with grease seals and these seals are extremely important in preventing the grease and dirt coating on track bolt nuts from wedging back through the sockets to the bearings and the rollers. The recesses in the wrench arm, immediately back of the sockets, must be packed with grease. Check this grease daily against any evidence of dirt or grit. In case of any uncertainty, rub the grease between the thumb and forefinger for any indication of grit and, if the lubricant feels dirty, replenish at once. Do not operate without first inspecting the sockets for their grease seals -- then make sure the wrench arm spindle bearings are packed with a fresh supply of grease.

Nordberg - Model DW

8560. The normal operating speed of the Model BP Briggs & Stratton engine serving this wrench is 2900 r.p.m. With the engine at this speed, the chuck r.p.m. in high gear will be 122. In low gear the chuck r.p.m. is 35.

8561. Operating control rod handle, part W-1036, on the left-hand side, is in the high-speed position when it is DOWN and in the low-speed position when it is UP.

8562. The operating handle, part W-1035, on the right-hand side shifts the engine for alternate engagement of either one or the other of the two faces of reverse bevel friction, part W-964, with the motor-driving friction, part W-967. This same operating handle controls the reverse and forward motion and, with the high and low gear transmission, provides two speeds in reverse and two speeds forward.

8563. Overload lock lever cable, part W-1041, is used only when in low gear. It is then pulled up to lock out the overload release from disengaging when full power is needed to break a “frozen” nut.

8564. Never at any time tighten a bolt in high gear. High gear is used exclusively to run-up or back-off a free nut. Final tightening must be done in low gear. Furthermore, when breaking a nut loose prior to running it off, low gear must also be used.

8565. The overload release operates only in low gear, as will be explained later, but caution must be taken to use low gear for final tightening and for breaking a nut loose just before backing it off. When the nut is free on the bolt, high gear can be used.

(NOTE: NOT ACTING STRICTLY IN ACCORDANCE WITH THE ABOVE OPERATING INSTRUCTIONS WILL DESTROY THE MOTOR-DRIVING FRICTION.)

8566. Weekly inspections must be made to determine the oil level in the transmission case by removing the plate held in place by four cap screws at the top of the transmission case. An inch of the gear, part W-940, should be submerged in oil. In other words, this gear is the oil gauge and the oil level must be maintained so as to allow the gear to dip into the oil. It is recommended that S.A.E. 10, Material Catalog Ref. No. 37-87, be used for this lubricant.

8567. The clutch adjusting lock springs, part W-991, are described on manufacturer’s Parts List, Sheet TW-27-V. These two clutches are very sensitive to adjustment and any adjustment should be made one notch at a time, as one notch more may prevent full and complete shifting. A tool is provided to lift up the spring, part W-991, out of engagement with the clutch adjustment collars, part W-992. The clutch adjustment collars are turned to the right to tighten up the clutch, or to the left for loosening.

8568. The overload release is described on manufacturer’s Parts List, Sheet TW-30-V, where the two overload release springs, part W-670-B, will be noted. These springs are com-
pressed by adjusting nuts and govern the torque applied in tightening track bolt nuts. In explanation of the mechanical working of this release, it first should be noted that the transmission is pivotally mounted. Secondly, and very important in knowing this release, is the fact stressed before in these instructions — that the release operates only in low gear. Therefore, in tightening a nut in low gear, the transmission gear, part W-940 (described on manufacturer’s Parts List Sheet TW-26-V) has a tendency to crawl up on the small clutch gear, part W-945, which exerts a torsional twist to the transmission case, allowing it to tilt. This motion, through the connection clutch, part W-1047, operating shaft spacer, manufacturer’s Parts List Sheet TW-30-V, will disengage the operating trip rollers, part W-1031. Simultaneously with this disengagement, the engine automatically moves into neutral position.

8569. The crankcase in Model BP Briggs & Stratton engine must be drained every 40 hours and refill with S.A.E. 10, Material Catalog Ref. No. 37-87, or S.A.E. 20, Material Catalog Ref. No. 37-56, depending on the weather conditions.

8570. The square ends of the socket spindle engaging the sockets must be greased daily. At the end of each day’s run, this grease must be cleaned out thoroughly and replenished. Apply grease freely so that when the socket is put back in place the grease will ooze out. Periodic inspections must be made as to the condition of the socket spindle bearings, and as soon as any excessive wear is detected these must be replaced. Do not use a badly worn spindle with new sockets. Do not try to salvage these sockets or socket spindles by welding them, as any heat applied to the spindle will draw the temper. Furthermore, the contour at the square ends of the socket spindle must be accurate and these parts cannot be reformed by welding other than at the factory.

8571. The socket holder plates must be inspected constantly. When wear is \( \frac{1}{8} \)” they must be immediately replaced.

8572. The adjustment for motor-driving friction is described on manufacturer’s Parts List, Sheet TW-26-V. The wear on part W-967 can be compensated for by adjusting the motor-friction adjusting nut, part W-970. Turning the nut to the right will force the cone-shaped friction out toward the end of the engine crankshaft and nearer the two faces of the reverse bevel friction, part W-964.

8573. Before starting the engine, both the reverse bevel friction, part W-964, and the motor-driving friction, part W-967, must be inspected very carefully for any accumulation of cinders or grit. Cinders will cut in and score both the frictions if this precaution is not taken.

8574. The motor-driving friction, part W-967, is drilled in one place only to accommodate the ball lock, part W-971; therefore, when adjusting the friction, make sure to turn the adjusting nut, part W-970, a full turn, or turns, depending upon how much movement is needed to bring the friction, part W-967, within 1/32” of touching either face of the reverse bevel friction when the engine is in neutral position. In other words, with the engine in neutral position, there should be 1/32” clearance on each side between the motor-driving friction, part W-967, and the reverse bevel friction, part W-964.

8575. The machine is equipped with sealed ball bearings greased to run for a period of six months without attention. At the end of this time the machine must be stopped and thoroughly dismantled. Every part must be checked for wear and replacements made. Bearings must be thoroughly cleaned and repacked for the next six months’ run. Use a good grade of bearing lubricant.
8580. These are multi-vane type of air motor. Same lubrication instructions apply as to other multi-vane motors.

8581. Some of these wrenches are equipped with rubber accumulators, while others are equipped with spiral hammer springs. Rubber accumulators must be removed after every 24 hours of service, or oftener if conditions warrant, and the grease cleaned from the rubber with a brush and gasoline. Kerosene must not be used, and the rubber must not be left to soak in gasoline, as disintegration of rubber will result.

8582. The outside diameter of the metal top and of the accumulator, and the inside diameter of the top and of the hammer, must be kept clean and free from rubber. This bearing surface must be slightly lubricated, as the hammer must be free to rotate and slide with respect to the top of the accumulator. Wiping with a greasy finger is enough. Before reassembling, put grease inside the anvil and in the upper end of the arbor. Also coat the jaws and faces of the hammer and anvil with grease. Never apply excess grease at any point so that it will get on the rubber, as it will shorten the life of the rubber.

8583. Wrenches with spring and cam impact units must be inspected to see that cam roller pins are tight and that roller pin cotters are intact. About two tablespoonfuls of grease must be placed inside of hammer and outside of cam. No damage will be done here with surplus grease.
### Spark Plugs - Types and Makes

<table>
<thead>
<tr>
<th>Make</th>
<th>18 Millimeter</th>
<th>14 Millimeter</th>
<th>10 Millimeter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Champion</td>
<td>4-Comm.</td>
<td>6-Comm.</td>
<td>4-Comm.</td>
</tr>
<tr>
<td>A.C. Autolite</td>
<td>B-3</td>
<td>B-4</td>
<td>A-3</td>
</tr>
<tr>
<td>Champion</td>
<td>4-Comm.</td>
<td>4-Comm.</td>
<td>4-Comm.</td>
</tr>
<tr>
<td>A.C. Autolite</td>
<td>A-3</td>
<td>A-4</td>
<td>A-4</td>
</tr>
<tr>
<td>Champion</td>
<td>5-Comm.</td>
<td>6-Comm.</td>
<td>4-Comm.</td>
</tr>
<tr>
<td>A.C. Autolite</td>
<td>A-4</td>
<td>A-5</td>
<td>A-5</td>
</tr>
<tr>
<td>Champion</td>
<td>7-Comm.</td>
<td>8-Comm.</td>
<td>4-Comm.</td>
</tr>
<tr>
<td>A.C. Autolite</td>
<td>A-5</td>
<td>A-6</td>
<td>A-6</td>
</tr>
<tr>
<td>Champion</td>
<td>8-Comm.</td>
<td>9-Comm.</td>
<td>4-Comm.</td>
</tr>
<tr>
<td>A.C. Autolite</td>
<td>A-6</td>
<td>A-7</td>
<td>A-7</td>
</tr>
</tbody>
</table>

The above listed spark plugs are standard for the heat ranges shown. Where abnormal operating conditions cause chronic fouling, the use of a type plug one or two numbers higher (a "hotter" type) than listed may remedy the condition, and where chronic pre-igniting or rapid electrode wear is experienced, a type one or two numbers lower (a "cooler" type) may eliminate the trouble. Such type plugs may be found in catalogue of the spark plug manufacturer and should be specially ordered in accordance with engine manufacturer's recommendations.

For plugs with reaches above normal and those of special design, replacements should be specially ordered.
## RECOMMENDED SPARK PLUGS FOR ENGINES USED IN M. of W. EQUIPMENT

**By Account and Reference Numbers -- Account 1-C**

<table>
<thead>
<tr>
<th>Ref. No.</th>
<th>Size</th>
<th>Make of Engine</th>
<th>Model of Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>533</td>
<td>7/8-18</td>
<td>Waukesha, Hercules, Le Roi</td>
<td>ER, VR, EU, IX, JX, RCX, CT, CR, 2C</td>
</tr>
<tr>
<td>1301</td>
<td>18 MM</td>
<td>Waukesha, Onan</td>
<td>6BL, 6BZ, ICK, WAK, W-3</td>
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<tr>
<td>532</td>
<td>14 MM</td>
<td>Le Roi</td>
<td>D-71W</td>
</tr>
<tr>
<td>536</td>
<td>14 MM</td>
<td>Briggs &amp; Stratton, Chrysler Industrial, Le Roi</td>
<td>NPR, 14, 19, 23, All 14 MM heads, D-226, Tractairs</td>
</tr>
</tbody>
</table>

### MOTOR CARS

<table>
<thead>
<tr>
<th>Ref. No.</th>
<th>Size</th>
<th>Make of Engine</th>
<th>Model of Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>5680</td>
<td>1/2&quot; Pipe</td>
<td>Fairmont, Fairbanks-Morse</td>
<td>SM-2, M-2, M-9, M-19, 40, 40-B</td>
</tr>
<tr>
<td>533</td>
<td>7/8-18</td>
<td>Kalamazoo</td>
<td>25, 25-A, 23</td>
</tr>
<tr>
<td>4572</td>
<td>18 MM</td>
<td>Fairmont, Kalamazoo</td>
<td>M-14, A-5, S2E</td>
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<tr>
<td>5725</td>
<td>18 MM</td>
<td>Fairmont</td>
<td>16, 16-L, A-3</td>
</tr>
<tr>
<td>2227</td>
<td>14 MM</td>
<td>Fairmont, Kalamazoo</td>
<td>A-6, 56, 56-A, 57, 57-A, 57-B</td>
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</tbody>
</table>

For engines not listed above, refer to the Spark Plug manufacturers' listings.
LUBRICATION OF MAINTENANCE-OF-WAY MACHINERY AND WORK EQUIPMENT

8800. Many machine failures are caused by lack of, or improper, lubrication. Proper lubrication procedures must be followed to insure that the lubricants reach and protect the bearing and wearing surfaces.

8801. The operator is responsible for the proper lubrication of his machine, its accessories, and all attachments.

8802. Only approved lubricants of the correct weight or consistency must be used. P.R.R. Material Catalog References for specific types, weights and consistencies of certain lubricants are given in following paragraphs.

8803. In the absence of specific instructions in this Manual, the machine manufacturer's recommendations should be followed.

8804. Lubricants must be kept in tightly closed containers and protected from becoming contaminated with water, dirt or fuel.

8805. Lubricants which have become contaminated should not be used for lubricating equipment.

8806. Lubrication fittings and the nozzle of the grease gun must be wiped clean of grease and dirt with a clean cotton cloth before applying the grease gun to the fitting.

8807. Caps of grease and oil cups must be closed at all times except when filling.

8808. When removing plugs from gear cases, care must be exercised to prevent dirt getting into the case.

8809. The level of lubricant in gear crankcases must be checked frequently and kept at the proper operating level.

8810. Avoid the application of excessive lubricant to ball and roller bearings. Excessive lubricant can cause heating of the bearing and damage to the seals.

8811. Lubricant should be applied to plain bearings until the lubricant appears at the side of the bearing. The excess must then be wiped off.

8812. Exposed roller chains, cables, and other working parts must be lubricated only as recommended by the manufacturer. Lubrication of these exposed parts in dusty or dirty conditions may result in excessive wear.

8813. Do not mix two different lubricants or a lubricant and a fuel in an effort to get a particular weight or consistency unless the mixing is specifically described in this Manual.

8814. P.R.R. DETERGENT LUBRICATING OILS (COMMERCIAL) FOR M.W. MACHINES:

<table>
<thead>
<tr>
<th>Material Catalog Ref. No.</th>
<th>Grade</th>
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<tbody>
<tr>
<td>Lubricators 37-338</td>
<td>S.A.E.</td>
</tr>
<tr>
<td></td>
<td>5W</td>
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<tr>
<td></td>
<td>10</td>
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<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>20W</td>
</tr>
<tr>
<td></td>
<td>30</td>
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Detergent oils must not be used in air filters.
## OILS

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<th>S.A.E.</th>
<th>Material Ref. No.</th>
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<tr>
<td>10 &amp; 10W</td>
<td>37-87</td>
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<tr>
<td>20 &amp; 20W</td>
<td>37-56</td>
</tr>
<tr>
<td>30</td>
<td>37-346</td>
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<tr>
<td>40</td>
<td>37-59</td>
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<td>Neutral Oil</td>
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## GREASES

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<tr>
<td>80</td>
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<td>37-235</td>
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<tr>
<td>90</td>
<td>E.P.</td>
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<td>140</td>
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<td>37-35</td>
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<td>250</td>
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Multi-Purpose, 1-lb. Cartridges (50 Cartridges per Case): 37-196

<table>
<thead>
<tr>
<th>Cup No.</th>
<th>Material Ref. No.</th>
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<tbody>
<tr>
<td>3</td>
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<tr>
<td>5</td>
<td>37-100</td>
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</table>

Worm and Worm Wheel Grease: 37-155
(For use in open gears of Burro Cranes)