No. 1962

HANDBOOK OF THE

ARTILLERY REPAIR TRUCK BODY MODEL 1918

FIFTY-FOUR PLATES

August 1, 1918

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WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
WASHINGTON, Aug. 1, 1918.

This manual is published for the information and government of the Regular Army, National Guard, and National Army of the United States.

By order of the Secretary of War:

C. C. WILLIAMS,
Maj. Gen. Chief of Ordnance, U. S. A.

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HANDBOOK OF THE ARTILLERY REPAIR TRUCK BODY MODEL 1918

CHAPTER I.

GENERAL DESCRIPTION AND INSTRUCTIONS.

GENERAL WEIGHTS AND SPECIFICATIONS.

Weight of body empty ..... 3060 lb.
Weight of body with full load ..... 7040 lb.
Length of platform ..... 132 31/32 in.
Length with drop end down ..... 156 31/32 in.
Width of body platform ..... 71¾ in.
Width with drop sides down ..... 119¾ in.
Height of drop sides ..... 24 in.
Height of drop end ..... 24 in.
Chassis used ..... Nash 2-ton or F. W. D. 3-ton
Floor material ..... poplar, 1½ in. thick
Body equipment ..... Lantern, axe, safety can, lantern bracket straps, canvas buckets, bucket straps, canvas cover, hatchets, pick-axe, short-handled shovels, straps for implements

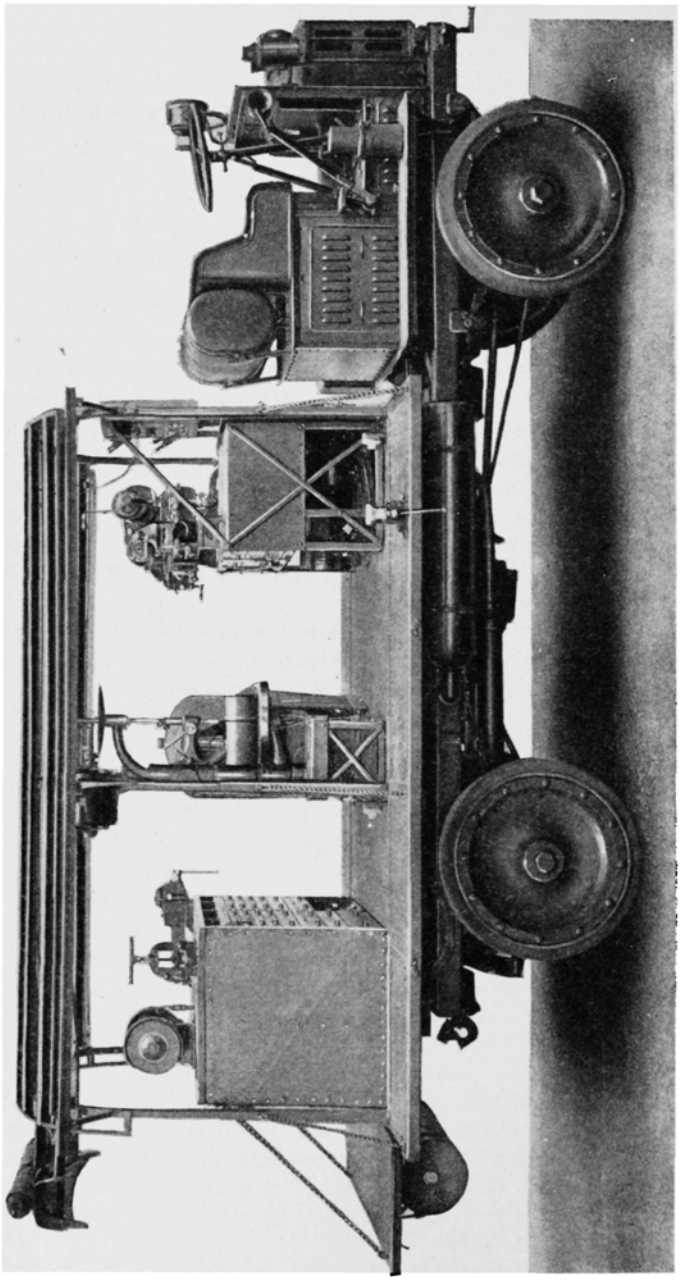
GENERAL DESCRIPTION

The Artillery Repair Truck Body, model 1918, is mounted on the 3-ton F. W. D. or the 2-ton Nash chassis, and is intended for the purpose of effecting repairs in the field. The nature of its equipment is such that repairs of a highly varied nature can be undertaken. The tool equipment takes in all the essential outfit of a machine shop, and is also suitable for a wide variety of bench work. Among the larger tools and equipment of the body there is a lathe, drill press, complete engine-generator set for generating the current to run the machines, complete bench cabinet, acetylene welding and cutting unit, grinder, and an air-compressor set with a complete set of hammers and chisels.

Power for the various repair units is supplied by the electric generator driven by the gasoline engine. This feeds the motors which run the drill press, lathe grinder, etc. It also takes care of the electric illumination of the body and provides current for the sockets into which are plugged the connectors for the air-compressor set. The master control is by means of an electric switchboard mounted at the front end of the truck, while the individual machines are taken care of by switches on the motors which operate them.

The engine motor-generator set acts as the power station for all the

PLATE No. 1



RIGHT SIDE OF ARTILLERY REPAIR TRUCK MODEL 1918.

machines mounted on the truck body. It is therefore essential that this system should be kept in the best possible condition. Good performance of the motor-generator set means an adequate supply of power to run the various machines comprising the body load. It can only be secured if the gasoline engine, which is the initial power source, be kept running at its highest efficiency.

The lathe, drill press, bench cabinet, etc., are all equipped with a sufficient number of tools and fittings to permit of a widely varied line of repair work. The lathe is mounted across the front end of the body on a special frame of light structural steel material. The space beneath the lathe is utilized for the storage of the air-compressor set and the stove pipe for light forging work. There are also two drawers for lathe equipment.

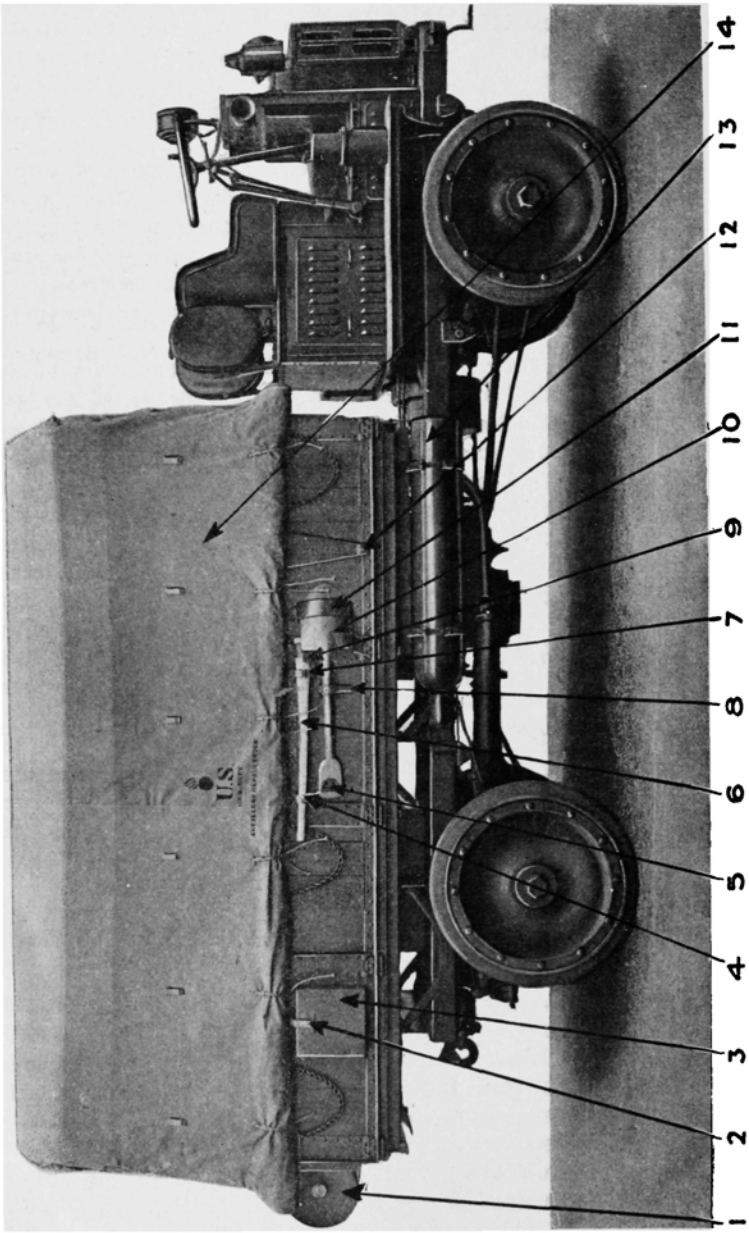
The center of the body is occupied by the engine motor-generator set on the left and the drill press on the right. Across the rear of the body is the bench cabinet, which is fitted with fifteen drawers, in which are contained a complete assortment of bench tools. Mounted on the bench is a bench vise and a bench grinder with two grinding wheels. There is plenty of room to operate these machine tools on account of the aisle space on the body itself. Additional room is gained by letting down the drop sides and drop end. These drop pieces each add twenty-four inches to the width or length of the body platform. By lowering the two drop sides a total floor width of 119¾ in. is secured. The normal width of the body platform is 71¾ in. The length of the body platform is 132 31/32 in. without the drop end down. With this lowered the length is increased to 156 31/32 in.

The body is mounted on either the Nash 2-ton truck chassis or on the 3-ton Four-Wheel-Drive chassis. The body is identical, whether mounted on the Nash or F. W. D. chassis. For complete details of the 2-ton truck chassis, Nash model 4017-A and 4017-L, see handbook No. 1999. For complete details of the 3-ton truck chassis, F. W. D. model B-1917, see handbook No. 1997.

BRIEF DESCRIPTION NASH 2-TON CHASSIS, MODELS 4017-A AND 4017-L. WEIGHTS AND OUTLINE SPECIFICATIONS.

Rated load capacity	4,000.00 lb.
Body weight allowance	1,200.00 lb.
Weight of chassis only	6,700.00 lb.
Maximum gross w'ght (including chassis, body and pay load)	11,900.00 lb.
Percentage of chassis weight on front tires (without load)	66.66
Percentage of chassis on rear tires (without load)	33.33
Percentage of load weight on front tires	30.00
Percentage of load weight on rear tires	70.00
Percentage of gross weight on front tires	45.00
Percentage of gross weight on rear tires	55.00

PLATE No. 2



Over-all length of chassis (without body).....202.50 in.
Over-all width of chassis (at widest part).....78.50 in.
Chassis wheelbase .....124.00 in.
Length of frame back of driver's seat.....117.13 in.
Height of rear end of frame from ground, loaded.....35.50 in.
Height of rear end of frame from ground, unloaded.....38.50 in.
Diameter of turning circle.....50.00 ft.
Tread of front wheels.....60.50 in.
Tread of rear wheels.....60.50 in.
Road clearance under front axle (lowest point).....14.75 in.
Road clearance under rear axle (lowest point).....14.75 in.

Engine—Four-cylinder, 4-cycle, L-head type, cylinders cast en bloc, with integral head. Bore, 4.25 inches; stroke, 5.5 inches; horsepower, 28.9, N. A. C. C. rating.

Cooling—Water, centrifugal-pump circulation.

Lubrication—Force feed, using drilled crankshaft; spray to cylinders.

Radiator—Tubular type, with fins, removable cast-iron headers.

Ignition—Eisemann high-tension variable spark magneto, type G4-11 Edition. Model 4017-L fitted with an impulse starter.

Carburetor—Type M-2, 1.25-inch Stromberg, plain tube type, with hot-air connection.

Fuel Feed—From main tank, 27 gallons capacity to auxiliary tank, holding two quarts, from latter to carburetor by gravity.

Governor—Fly-ball type, drives through flexible shaft from camshaft, and is mounted between carburetor and short external inlet manifold.

Clutch—Single plate, dry disk, fitted with clutch brake.

Transmission—Selective, sliding-jaw clutch type, combined with silent chain reduction. Four speeds forward, one reverse.

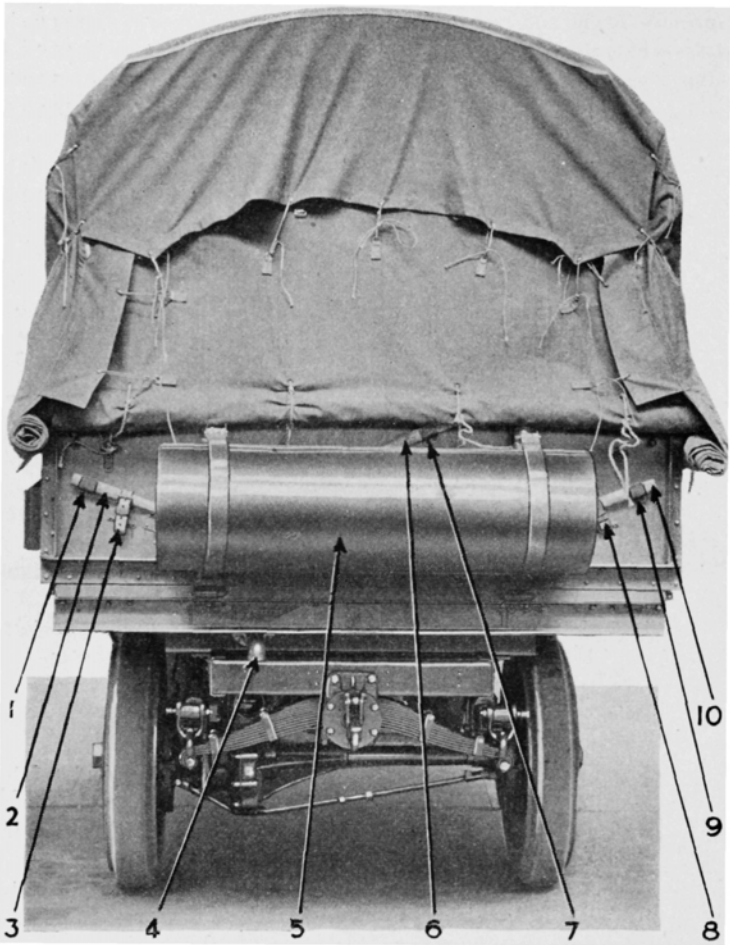
Drive—Drive from transmission through two propeller shafts fitted with Spicer universal joints, then to bevel ring gear in axles, and through axles to internal gearing in four wheels. Torque absorbed through springs. Full Hotchkiss drive.

Frame—Channel section pressed steel. Six cross members. Five

RIGHT SIDE VIEW OF ARTILLERY REPAIR TRUCK.

1 Air receiving tank.
2 Water bucket strap.
3 Water bucket bracket.
4 Pick axle handle rest.
5 Shovel handle bracket.
6 Pick axe.
7 Pick axe handle strap.
8 Shovel handle strap.
9 Pick head bracket.
10 Shovel, short handle.
11 Shovel support.
12 Vise reinforce.
13 Oxygen tank (200 cu. ft. cap.)
14 Canvas cover for truck.

PLATE No. 3



ARTILLERY REPAIR TRUCK—REAR END.

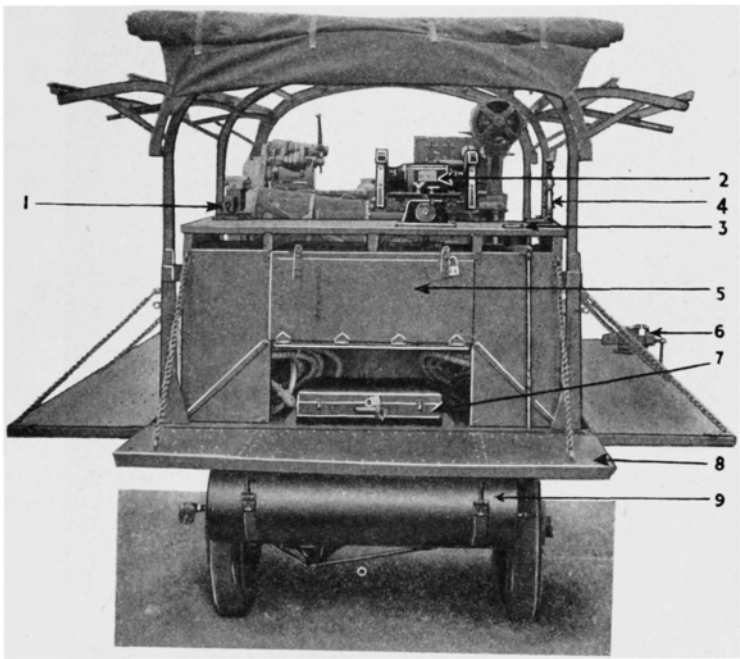
1 Hatchet handle bracket.
2 Hatchet.
3 Hatchet handle strap.
4 Exhaust outlet—motor generator set.
5 Air receiving tank.
6 Axe.
7 Axe handle bracket.
8 Hatchet handle strap.
9 Hatchet handle bracket.
10 Hatchet handle.

standard ordnance transoms. Ordnance pintle at rear, towing hooks in front.

Springs—Front and rear semi-elliptic, with auxiliary coil springs.

Axles—Front and rear identical. Bevel pinion and gear, with M. & S. locking type differential at propeller shaft and internal gear at wheels.

PLATE No. 4



REAR VIEW OF BODY—END DOWN.

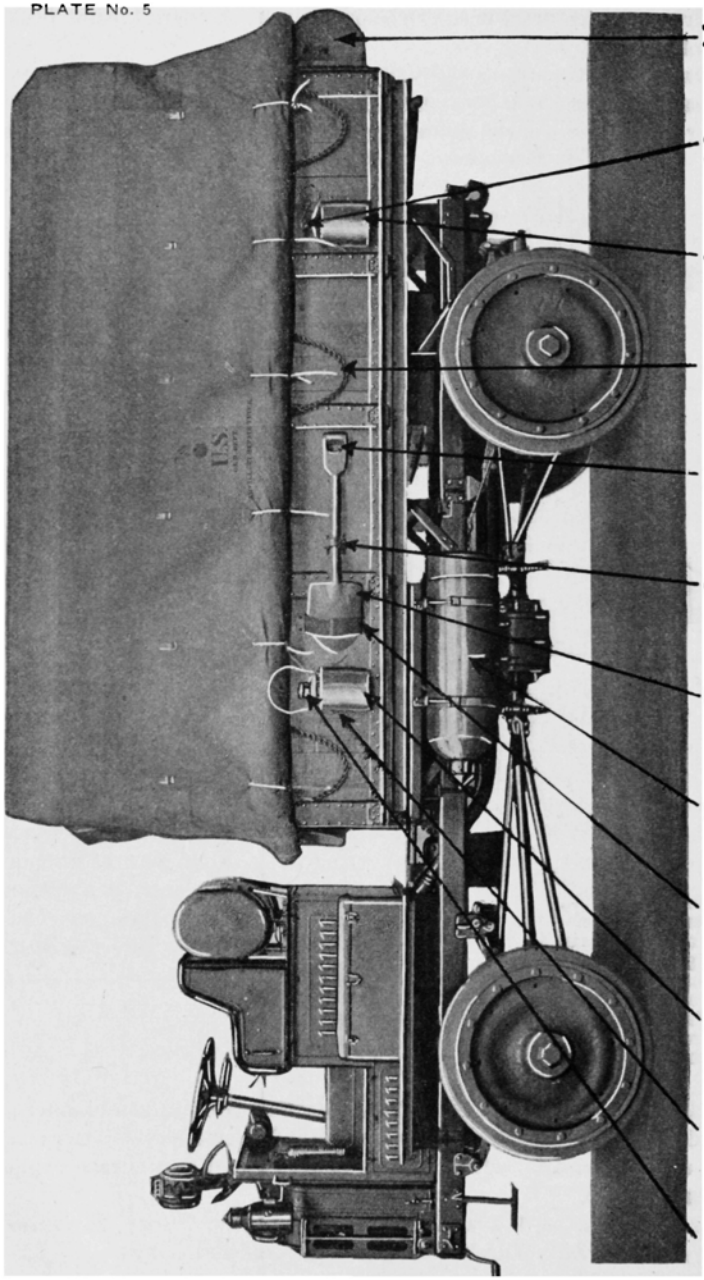
1 Bench vise, 4 in.
2 Bench grinder.
3 Water pot—grinder.
4 Pipe vise.
5 Rear upper compartment door.
6 Machinists' vise—swivel jaw.
7 Welding and cutting supplies case.
8 Drop end.
9 Air receiving tank.

Brakes—Two sets of brakes. Pedal-operated service brake of internal expanding type in wheel brake drums. Hand-lever operated emergency brake of external contracting type on transmission; hand brake applies foot brakes also.

Wheels—Cast-steel disk wheels, all four identical. Wheels have brake drums cast integral. Wheels fitted with taper roller bearings.

Tires—36 inches x 6 inches, solid tires, pressed-on type.

PLATE No. 5



Steering—All four wheels used for steering. Vertical steering column. Steering gear of screw and split-nut type. Hardwood steering wheel.

Controls—Left-hand steer. Change gear and emergency brake levers in front of driver's seat to right of steering column. Spark and throttle lever operated on sector clamped below steering wheel on front of steering column. Ignition ground wire switch on left-side dash. Carburetor choke control on steering column. Clutch and service brake pedals left and right respectively. Accelerator pedal to left of change-gear lever.

Main Gasoline Tank—Steel tank, 27-gallon capacity.

Auxiliary Gasoline Tank—Steel tank, two quarts capacity.

Equipment—Pyrene fire extinguishers; non-skid chains, complete in chain box; eyes for non-skid chains; hand-operated horn; odometer; hand flashlight; Model 4017-A, fitted with speedometer; electric searchlight, electric side lamps, electric tail lamp, Bijur generator, storage battery. Model 4017-L, acetylene searchlight, acetylene generator, oil side lamps, oil tail lamp and speedometer.

BRIEF DESCRIPTION NASH MODELS 4017-A AND 4017-L.

With the exception of a few details of equipment these models are identical. The Model 4017-L uses an impulse starting device on the magneto shaft, while the 4017-A model has none; it uses acetylene lighting, while the 4017-A model employs an electric generator and storage-battery system; it is fitted with a speedometer in addition to an odometer, while the Model 4017-A has only an odometer.

The chassis is one of 124 inches wheelbase, and is fitted with a four-cylinder engine, dry-disk clutch, four-speed transmission, and a drive to all four wheels, through shafts and internal gear-drive axles which are identical front and rear.

The engine is a standard design L-head, of Buda make, using force-feed lubrication, pump cooling, and fitted with a Stromberg carburetor feeding through cored manifold cast integral with cylinder block, and Eisemann magneto, and on the Model 4017-A only, with a Bijur generator.

The clutch is of the dry-plate type, and the drive from it is through an open two-joint propeller shaft to a four-speed, sliding jaw clutch type, transmission. From the latter extend two two-joint propeller shafts,

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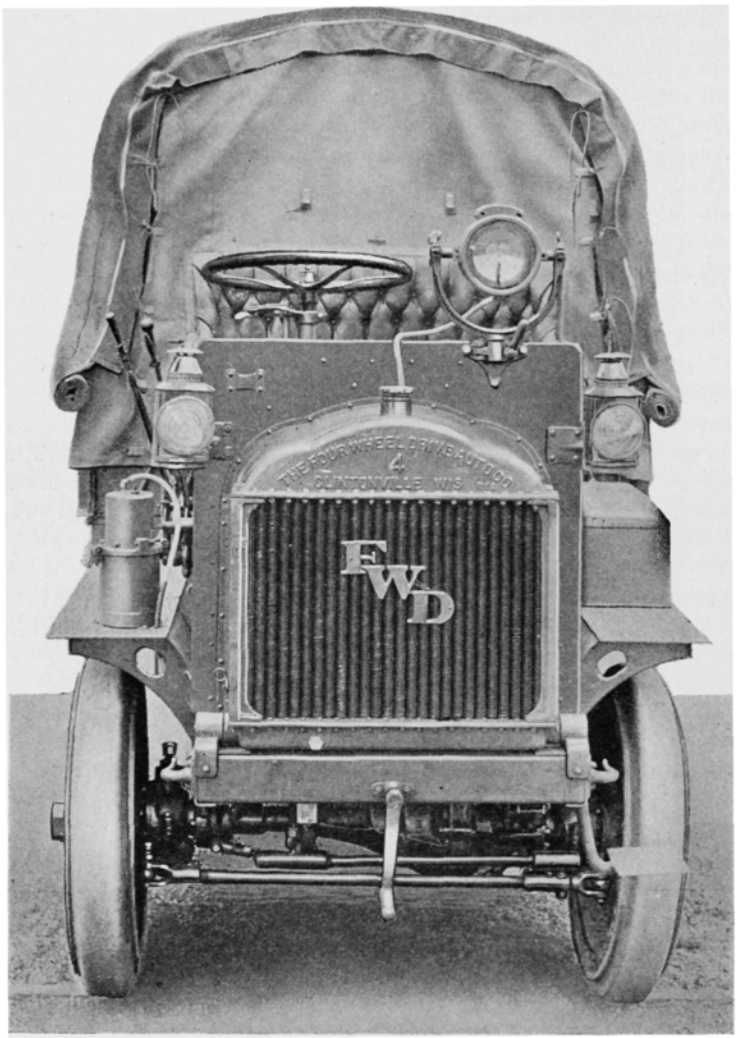
LEFT SIDE VIEW OF ARTILLERY REPAIR TRUCK.

1 Lantern.
2 Lantern bracket body.
3 Acetylene cylinder (200 cu. ft. cap.).
4 Shovel support.
5 Shovel, short handle.
6 Shovel handle strap.
7 Shovel handle bracket.
8 Drop side chain.
9 Lantern bracket body.
10 Safety can (Pyrene pat.) for gasolene.
11 Air receiving tank.
12 Lantern strap.

PLATE No. 6



FRONT VIEW ARTILLERY REPAIR TRUCK.

one forward and one rearward, to identical internal gear-drive axles. The live member has exposed axle shafts extending from it, and the ends of these shafts are each fitted with a universal joint and a spur pinion, the latter meshing with an internal gear bolted to a disk steel wheel. All the wheels are interchangeable, and are all driving and steering wheels.

SHORT DESCRIPTION OF 3-TON F. W. D. CHASSIS.

WEIGHTS AND OUTLINE SPECIFICATIONS.

Rated load capacity	6,000 lb.
Body weight allowance	1,200 lb.
Weight of chassis with transoms	7,308 lb.
Maximum gross weight loaded	14,510 lb.
Percentage of chassis weight on front tires (without load)	62
Percentage of chassis weight on rear tires (without load)	38
Percentage of load weight on front tires	19
Percentage of load weight on rear tires	81
Percentage of gross weight on front tires	47
Percentage of gross weight on rear tires	53
Over-all length of chassis (without body)	213.5 in.
Over-all width of chassis (at widest part at hubs)	70.5 in.
Chassis wheelbase	124 in.
Length of frame back of driver's seat	128 in.
Width of frame (outside dimensions)	36 in.
Height of rear end of frame from ground (empty)	39.5 in.
Height of rear end of frame from ground (loaded)	35.875 in.
Diameter of turning circle	50.5 ft.
Tread of front and rear wheels	56 in.
Road clearance under front axle (lowest point)	9.68 in.
Road clearance under rear axle (lowest point)	9.68 in.
Height of pintle from ground	29.25 in.

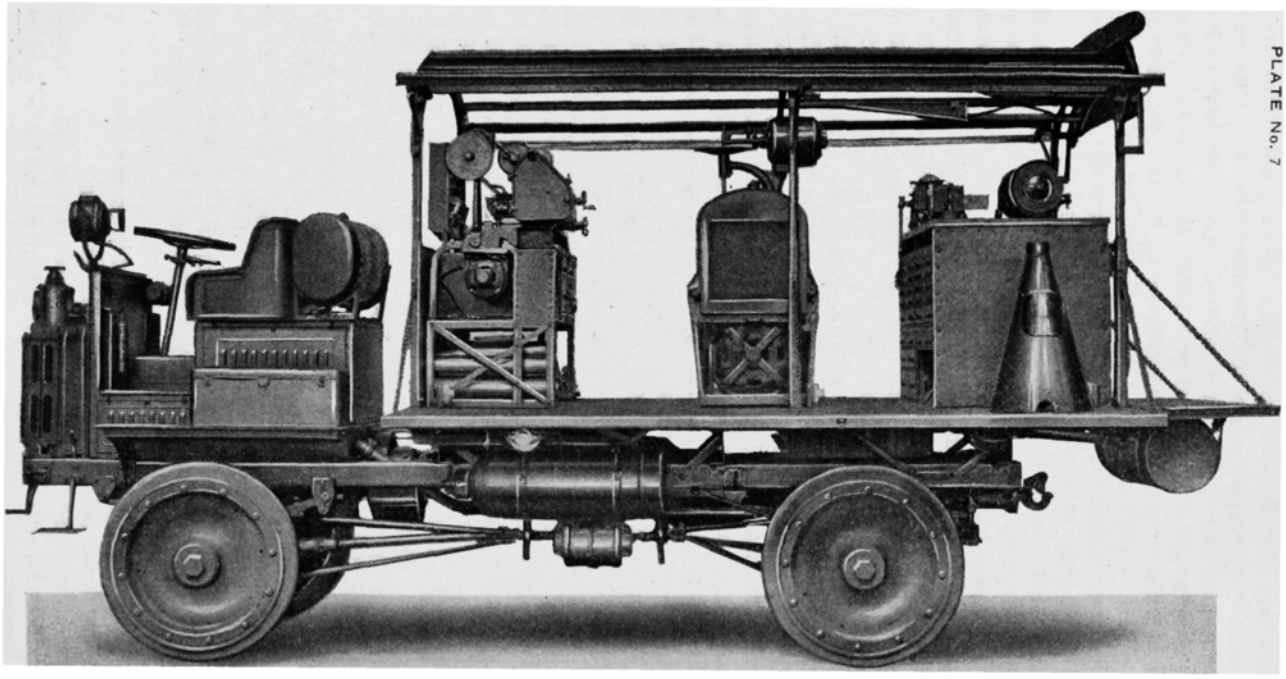
Purpose—This chassis will carry the body and load of the artillery repair and the equipment repair trucks, as well as standard ordnance supply and ammunition bodies.

Engine—Wisconsin make, 4-cylinder, cast in pairs, 4-cycle. Bore, 4.75 inches; stroke, 5.5 inches; N. A. C. C. rating, 36.1 hp. Mounted on 4 points on sub-frame. Lubrication by combined force feed and splash system. Centrifugal water pump.

Radiator—Tubular type, with fins, tubes soldered in. Head, base and sides cast separately and bolted together. Mounted by trunnions in brackets at front end of main frame.

Ignition—Eisemann high-tension, variable spark magneto, driven by shaft from the timing gears through a flexible coupling.

Carburetor—Stromberg Model G, having two fixed nozzles, spring-retained auxiliary air valves; equipped with hot-air connection to outside of exhaust manifold.



LEFT SIDE OF ARTILLERY REPAIR TRUCK.

Fuel Feed—Gasoline feed by gravity from tank behind driver's seat.

Governor—Pierce governor, of fly-ball type, mounted between carburetor and intake manifold. Driven from camshaft through flexible shaft.

Clutch—Hele-Shaw multiple-disk running-in-oil clutch. Twelve bronze drive disks. Eleven steel driven disks. Clutch brake provided.

Clutch Alignment Joint—Double universal type formed of two male and two female members.

Transmission—Suspended from sub-frame. Selective sliding jaw clutch type. Aluminum case. Three speeds forward, one reverse. All gears constantly in mesh. Final drive to front and rear axles through silent Link Belt chain, and (integral) bevel pinion type center differential. Hand-operated differential locking device.

Drive—Shaft drive from transmission through universal joints to bevel ring gear in axles.

Torsion Rods—V-shaped torsion rod of seamless tubing extending from collar on differential housing of each axle to bracket on main frame. Take torsion only, propulsion is through springs.

Frame—Channel section, heat-treated pressed steel, riveted together. Eight cross members. Five standard ordnance transoms. Frame 36 inches wide, 192 inches long. Ordnance spring-cushioned pintle at rear of frame and towing hooks in front.

Axles—Internal shaft, full floating type. Front and rear axles of same general type and construction, except front axles provided with ball members to accomplish steering. Central housing of axles encloses spur pinion type of differential. Wheel hubs fitted with roller bearings.

Brakes—Two sets. Service brake on transmission, operated by foot pedal. Hand-lever emergency brake of external contracting type, operating on rear wheel brake drums. Raybestos brake lining.

Wheels—Disk steel wheels, supported on axles by roller bearings. Rear wheels have brake drums cast integral.

Tires—Size, 36 by 6 inches.

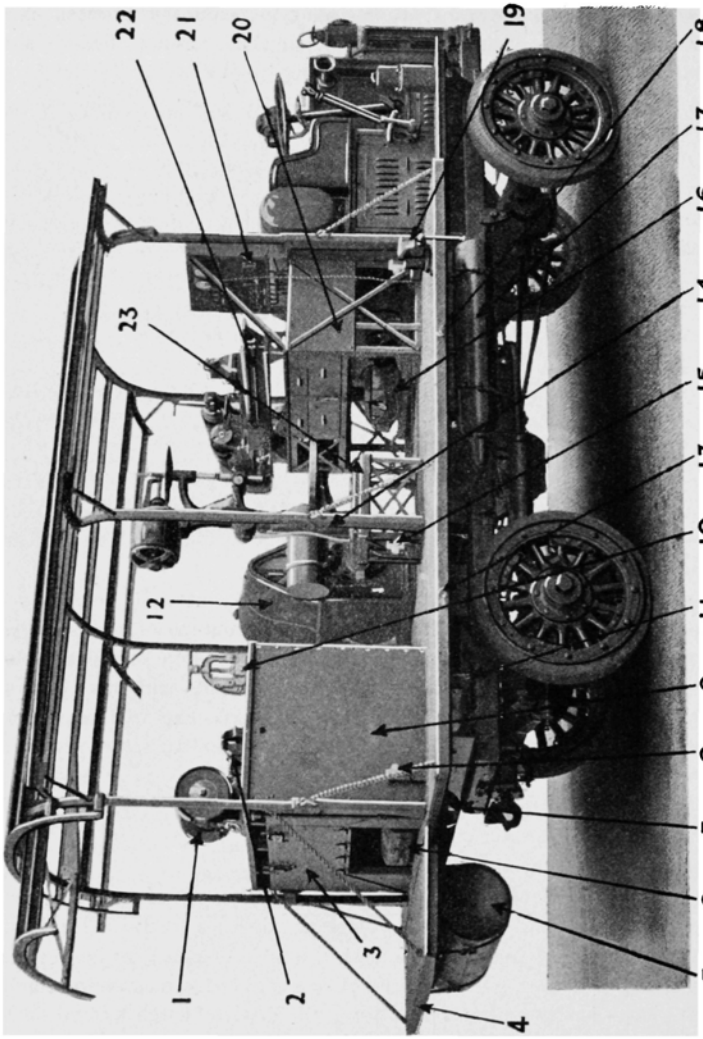
Steering—Front wheels only used for steering. Steering gear of differential screw type. Hardwood steering wheel; diameter, 22 inches.

Controls—Right-hand steer, gear shift and emergency brake levers at right of driver's seat. Spark and throttle levers operate on sector clamped to left-side steering column. Ignition ground wire switch located on heel board. Accelerator and cut-out pedals located on floor. Clutch and service pedals are located left to right respectively.

Gasoline Tank—Located behind driver's seat, galvanized steel elliptical receptacle of 30-gallon capacity. Gravity feed.

Equipment—Pyrene fire extinguisher; oil side lamps, oil tail lamp, acetylene searchlight, with swivel yoke and bracket; searchlight cover, acetylene generator with bracket, paulin 12 feet by 12 feet; non-skid chains complete and chain box; hand-operated horn; speedometer; hand

PLATE No. 8



RIGHT (REAR) VIEW OF ARTILLERY REPAIR TRUCK.

1 Bench grinder, with 2 emery wheels.
2 Machinist's vise, 4 in.
3 Bench cabinet door.
4 Drop end.
5 Air receiving tank.
6 Oxy-acetylene welding and cutting supplies cabinet.
7 Air compressor receptacle.

flashlight; 15 feet towing chain; instruction books with canvas cover; motor vehicle tool box, model 1918, including tools and spare parts.

REMOVE SLUSH.

On receipt of the truck the slush which covers the metal parts should be removed either with a dry cloth, or, if this will not remove it, take kerosene. After the slush is thoroughly removed re-oil all the parts in accordance with the instructions given under heading of the different pieces of equipment in the following chapters. All of the bench tools and the small metal tools and equipment should be wiped off with a rag to preserve them against rust. This is true of all tools in the entire equipment, as they will quickly become unfit for use unless protected by a film of oil or light grease against the effects of moisture.

CHECK EQUIPMENT.

One of the first pieces of work which should be done on the receipt of the body is to check over the equipment to find that none of it has been left off the body in transit. The equipment list on pages 146 to 152 can be utilized for this purpose. To check over the small pieces contained in the 15 drawers of the bench cabinet and in the 2 drawers of the lathe frame, the best place to refer is to the list of contents of drawers which appears on pages 99 to 110.

OIL WEARING PARTS.

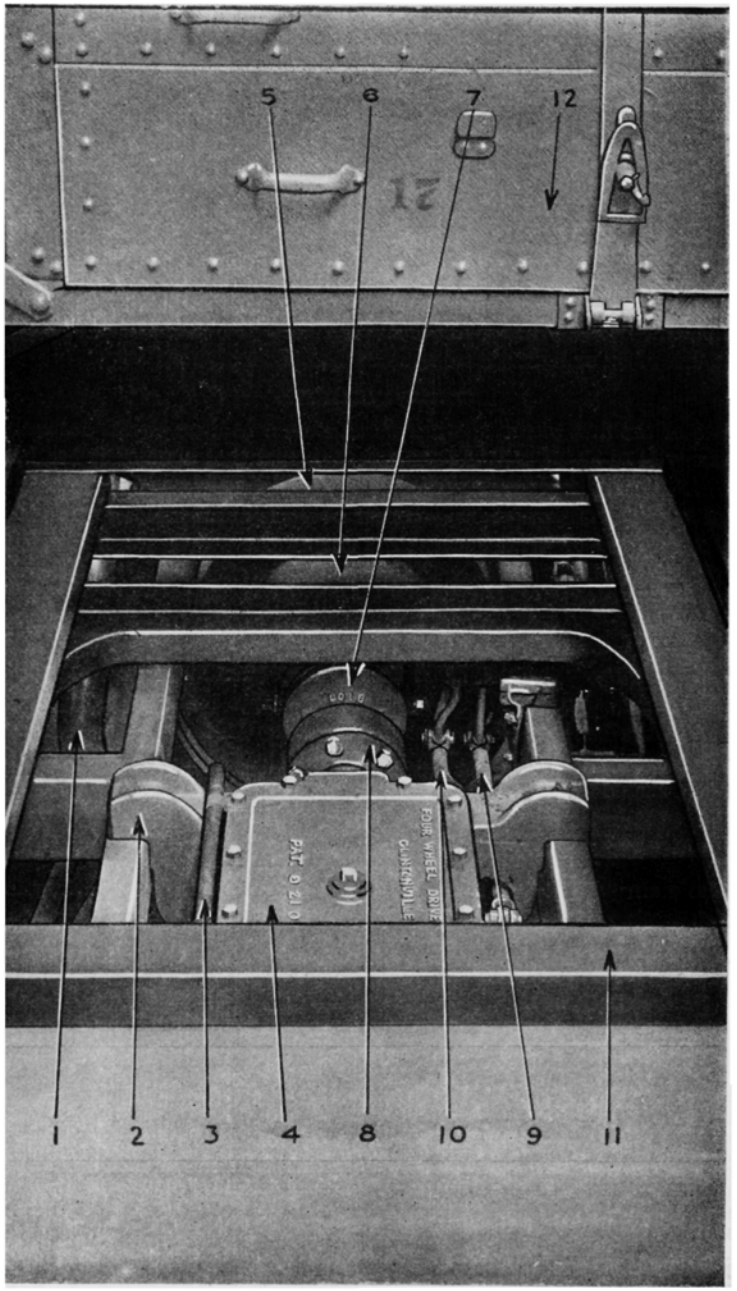
The wearing parts and joints on the body should be lubricated from time to time to preserve them against rust and to prevent binding. Such parts of the body as the hinges for the drop sides and drop end, the chain pivots, etc., the floor of the body, the chains, and various parts of the top, should be kept clean in order to preserve the life of the equipment and keep it in its highest state of efficiency.

MAIN UNITS ON BODY.

The main parts of the tool equipment are given in the following list, which is simply a general outline to show the scope of the work which

---

8 Receptacle (lamp).
9 Bench cabinet.
10 Pipe vise.
11 Bolt snap (for drop side chain).
12 Generating unit (gasolene, electric).
13 Hanger eye (for drill press tie rod).
14 Drill press.
15 Receptacle (lamp).
16 Air compressor outfit.
17 Oxygen cylinder (200 cu. ft. cap.)
18 Hanger eye (for drill press tie rod).
19 Machinist's vise, 3½ in., swivel jaw and base.
20 Lathe frame.
21 Switchboard.
22 9 in. screw cutting lathe.
23 Drill press frame.


5
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12
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11
FOUR WHEEL DRIVE
CLINTON, IOWA

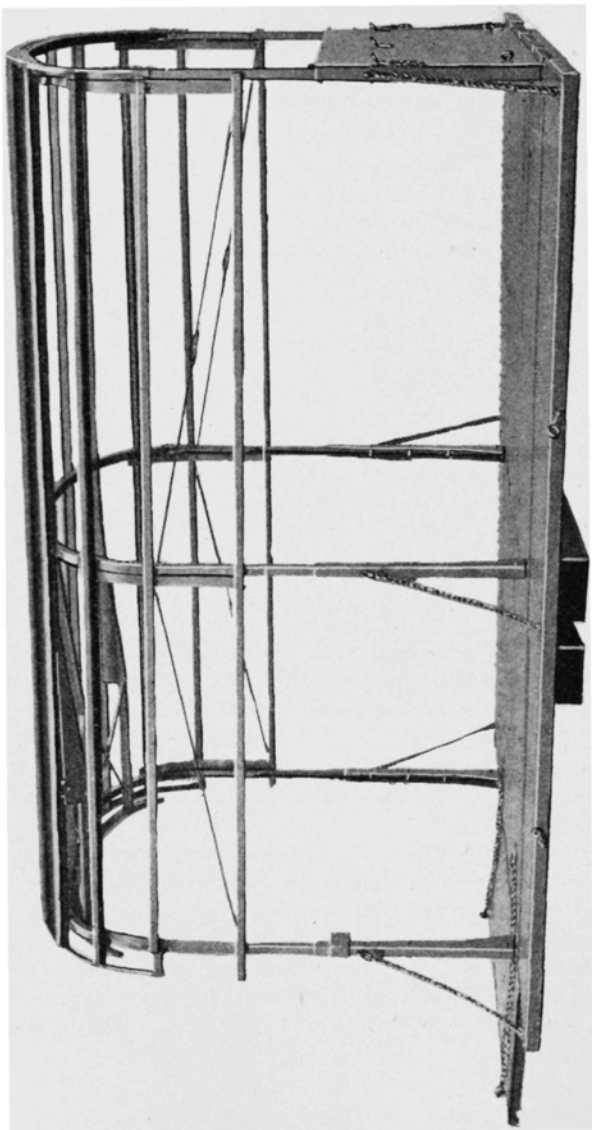
may be undertaken with this equipment. For a complete list of tools, equipment, and fittings on the body, the tabulations on pages 140 to 152 should be referred to. The larger pieces of equipment are given in the following lists:

1. Acetylene cylinder, filled.
2. Air compressor and motor complete.
3. Air-receiving tank.
4. Bench grinder with 2 emery wheels.
5. Die stock set.
6. Dresser, emery wheel.
7. Drill, portable; electric, heavy duty.
8. Drill press.
9. Oxygen cylinder, filled.
10. Generating unit.
11. Switchboard for generating unit.
12. Grinder, tool post type.
13. Grinder, automobile valve.
14. Lamp, adjustable floor.
15. Lathe complete.
16. Milling and gear-cutting attachment for lathe.
17. Oxy-acetylene welding and cutting outfit.
18. Pipe tool set.
19. Riveting set, button-head.
20. Stove, Sibley, complete.
21. Switchboard.
22. Tap and die set.
23. Three vises, two machinists' and one pipe.
24. Chipping tools.

VIEW OF CHASSIS—FRONT FALSE FLOOR REMOVED.

1 Exhaust pipe.
2 Transmission case lug.
3 Speedometer drive chain.
4 Transmission front cover plate.
5 Engine flywheel.
6 Engine clutch.
7 Clutch brake flange.
8 Clutch alignment joint.
9 2nd and 3rd gear shift rod.
10 1st and reverse, gear shift rod.
11 Standard Ordnance transom.
12 Drawer No. 17 (in lathe bench).

PLATE No. 10



BODY STRUCTURE FOR ARTILLERY REPAIR TRUCK.

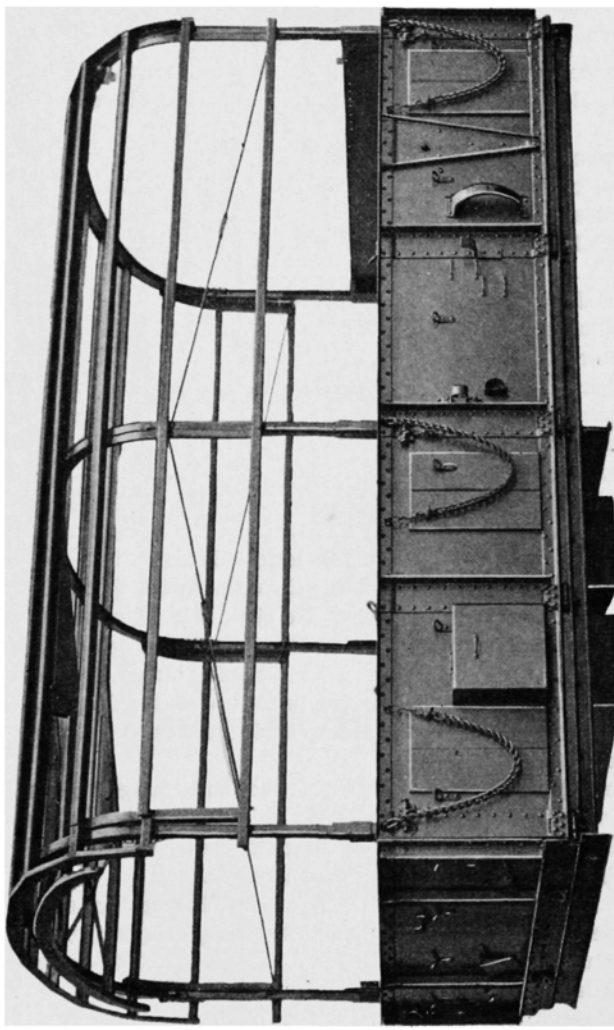
CHAPTER II.

BODY STRUCTURE.

GENERAL SPECIFICATIONS.

Structural material.....commercial steel stock
Longitudinal sills.....2½ x 2 x 3/16 angle
Draft sills.....2½ x 3 x 2 x ¼ flange steel
Transverse cross channels.....3 in., 4 lb. per ft.
Transverse cross angles.....2 x 2 x 3/16
Splice plates.....¼ in. thick
Corner reinforce.....¼ in. thick
Floor box.....3 32 in. thick flange steel
Floor box, depth.....7 29/32 in.
Floor box, width.....28 in.
Floor material.....poplar
Floor thickness.....1½ in.
Floor fastening.....⅜-in. carriage bolts
False floor, front.....30 x 42½ in.
False floor, rear.....30 x 21½ in.
Floor binding.....1½ x 1½ x ⅛ steel angle
Binding screws.....⅜ in., countersunk
Conduits.....12 ft. 1 in. loricated iron, 72 ft. ½-in. loricated iron, 200 ft. No. 14 R. C. S. B. solid copper wire, 50 ft. No. 12 R. C. S. B. solid copper wire, 40 ft. No. 4 R. C. S. B. solid copper wire, 5 ft. No. 16 double lamp cord, 2 attachment plugs, condulets, etc.
Drop side, left attachments.....Shot bolts, hinges, lantern bracket, bracket for Pyrene safety can, shovel blade bracket, shovel strap fastener, shovel handle bracket, hook eye, hanger eyes, bolt snaps, etc., reinforce.
Drop side, right attachments.....Shot bolts, hinges, bucket holder, hanger eye, chain wearing strips, reinforces, pick handle rest, pick head brackets, shovel blade bracket, shovel handle bracket, vise reinforce bolt snaps, strap fasteners, etc.
Drop-end attachments.....Shot bolts, hatchet blade and handle brackets, axe pocket and handle brackets, hanger eye, hinges, etc.
Drop side, material.....3/32-in. flange steel
Drop side, length.....132 in.
Drop side, height.....24 in.
Drop side, top reinforce.....2 x 2 x 3/16 in.
Drop end, material.....3/32-in. flange steel
Drop end, width.....75 7/16 in.
Drop end, height.....24 in.

PLATE No. 11



BODY CONSTRUCTION SHOWING DROP SIDES AND END UP.

Lathe frame, width ..... 56 in.
Lathe frame, height ..... 29 in.
Lathe frame, depth ..... 24 in.
Lathe frame, angle ..... 1½ x 1½ x ⅛ in.
Rheostat block ..... oak, 2 x 7¼ x 8 in.
Number of top bows ..... 6, 3 per side
Bow material ..... steel, 3/32 in. thick
Canvas support strips ..... 9, hickory

BODY STRUCTURE, GENERAL DESCRIPTION.

The body structure is made up of commercial flange steel and angle iron. It is 132 31/32 in. long by 71¾ in. wide. This can be enlarged by means of the drop sides and drop end to 156 31/32 in. long and 119¾ in. wide. The body is built up on longitudinal sills and sub-sills and draft sills. Transversely, the body is reinforced by angle or channel bars, which stiffen the structure. The junction points between the longitudinal members and the transverse members are secured by splice plates, which are riveted to the above members. The drop sides are hinged to the main body platform, and these hinges are supported by the transverse members, which carry the hinges at their outer extremities. Over the top of the structural work is laid a flooring of poplar, 1½ inches thick. Contained within the platform are two false bottoms, the one at the forward end being removable, and disclosing the transmission cases for lubrication and inspection purposes, and the rear covering a floor box which contains some of the tools.

Structural work on the body also includes the frame for mounting the lathe and drill press, and also includes a bench chest which contains 15 drawers capable of holding most of the small tool equipment and other parts furnished with the truck body.

The top of the body is carried on six bows, three on each side. These bows are arched over the top of the body, and carry nine long canvas supporting strips of hickory. The canvas top covers the body and extends down on each side, sufficient material being left to form a roll at the side, which can be extended out as a sunshade, or as rain protection, while the occupants of the truck are at work.

The top itself can be extended at the sides by hinged pieces which lift up or extend at the rear end by extension pieces, thus providing adequate shelter while the repair shop is in use.

The conduits for the electric wires are clipped to the structural work and convey the current from the motor generator set to the switchboard, and thence to the individual motors which operate the lathe drill press and bench grinder. There are also receptacles provided to plug in for operating air compressor set or any other electrical equipment not rigidly connected with the body.

The height of the top above the body can be adjusted by means of the

bow pins which fasten the bows to the upright stanchions on the sides of the body platform. These pins pass through holes in the stanchions and bows, and the height of the top above the body is governed by the holes in which the pins are placed.

The general layout of the parts on the body corresponds with the structure so that the stiffening members beneath take the load at the front end of the lathe and lathe motor; at the center, the motor generator set, and the drill press; and at the rear, the bench cabinet, and bench grinder. The drop sides and drop end provide the necessary floor space for working around any of these units and the drop sides and end are held horizontal by forged steel chains, 5/16 in. in diameter.

CHAPTER III

ENGINE—MOTOR—GENERATOR SET

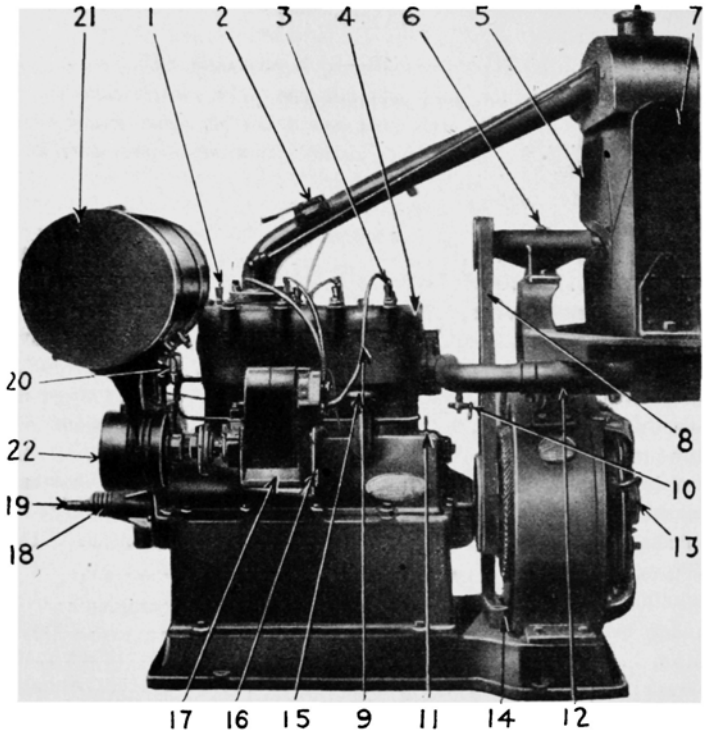
GENERAL SPECIFICATIONS.

Type of engine	four cycle
Number of cylinders	four
Cylinder diameter, bore	2⅝ in.
Stroke	4 in.
Brake horsepower	8 at 1100 r.p.m.
Cylinders cast	in block
Cylinder material	gray iron
Piston material	gray iron
Piston clearance	.003 in.
Number of piston rings	3 per piston
Connecting rod	I-beam forging
Piston pin bushing	bronze
Lower rod bearing	die cast babbitt
Crankshaft	drop forged steel
Crankshaft, diameter	1½ in.
Crankpin, diameter	1½ in.
Crankpin, length	1¾ in.
Cylinder head	detachable
Ignition	Bosch magneto
Governor	centrifugal type
Lubrication	circulating splash
Cooling	thermo-syphon
Gasoline tank capacity	5 gal.
Generator	multiple pole type
Voltage	110
Winding	compound
Capacity	4 kw.
Switchboard size	14 x 24 in.

GENERAL DESCRIPTION.

Electrical power to operate the various repair units mounted on the artillery repair truck body is supplied by an engine-motor-generator set mounted transversely across the center length of the body at the left side. This is a self-contained unit comprising an engine, direct connected with a generator, the armature of which acts as the flywheel of the engine. In connection with these two main components there is a radiator sufficiently large to take care of the cooling, a five-gallon gasoline tank and the necessary piping connecting these units. There is also an elec-

PLATE No. 12



FRONT VIEW OF GASOLENE ELECTRIC GENERATOR OUTFIT.

1 Priming cup.
2 Ignition switch.
3 Spark plug.
4 Cylinder head—removable.
5 Fan.
6 Fan shaft oil hole plug.
7 Radiator.
8 Fan belt.
9 Spark plug cable.
10 Cooling system drain cock.
11 Oil gage.
12 Water outlet hose.
13 Generator.
14 Starting crank.
15 Oil filler and breather.
16 Spark control bracket.
17 Magneto—Bosch DU-4.
18 Starting crank spring.
19 Crank shaft.
20 Oil sight feed.
21 Gasolene tank (5 gal. cap.).
22 Governor cover.

tric switchboard mounted at the front end of the body through which the current generated by the unit is controlled.

The unit mounted on the truck body is protected by screens on each side, and a screen which goes over the top. The switchboard is at the extreme front end of the body just ahead of the lathe frame, being a direct-connected unit. The speed of the armature is the same as that of the crankshaft.

ENGINE.

The engine has a four-cylinder unit with the cylinders cast in block. It has a bore and stroke of 2⅝ by 4 in. Manifolds are cast integrally with the cylinders and the cylinder head is detachable. Gray iron pistons are used with three piston rings, all of which are above the wrist pin. The pistons have a clearance of .003 in. and below the lowest ring are drilled to furnish an oil return passage for the lubricant scraped off the cylinder walls by the piston rings. The piston pin or wrist pin is hollow, hardened, and ground. It operates within a bronze bushing contained in the upper end of the connecting rod.

The connecting rod is a drop forging of I-beam section. At the lower end it contains die cast babbitt bearing for the crank pin.

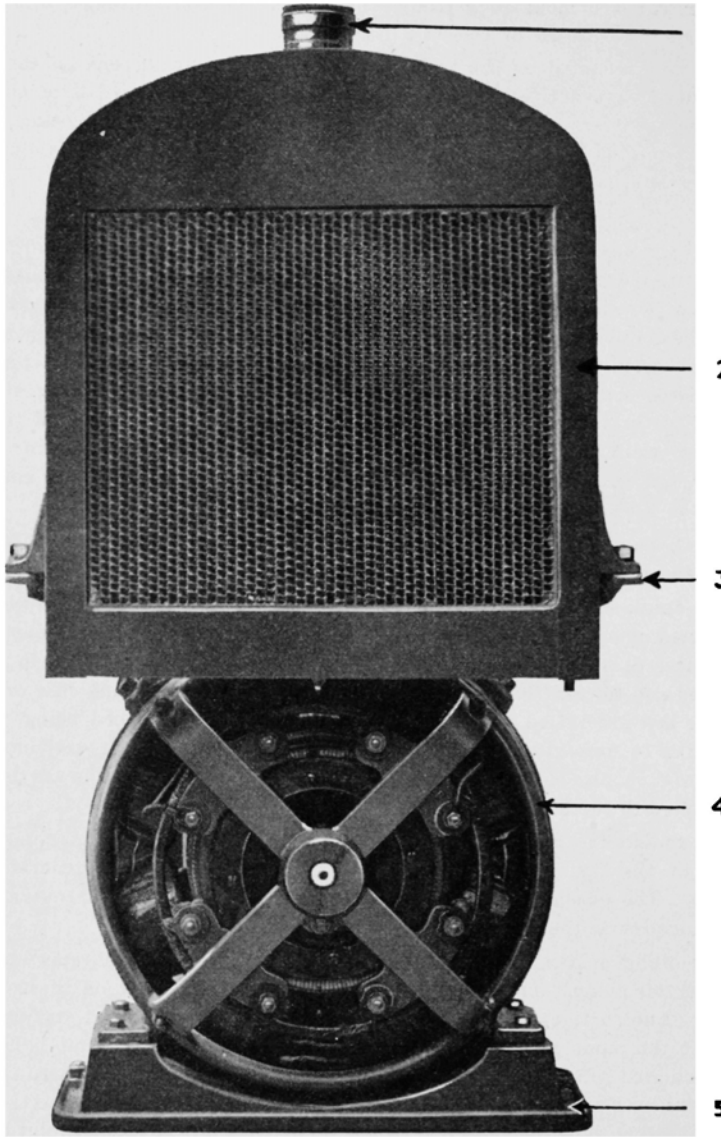
The crank shaft is a steel drop forging 1½ in. in diameter and direct connected at one end with the armature of the generator which acts as a fly wheel at the other extremity. The crank shaft terminates in a squared end to take the starting crank engagement. The crank case and engine bed are bolted together by flange connections, the bed being so shaped as to support the frame of the generator containing the stationary fields and to provide a substantial base upon which the unit is carried and bolted to the floor of the truck.

The radiator is an automobile type with a shield to secure the maximum draft of the fan. It is mounted on a frame bolted to the generator casing. The gasoline tank is supported on a bracket on the crank case of the engine at the starting crank end.

The oiling system is automatic, being taken care of by a removable plunger oil pump. The plunger is actuated by an eccentric on the cam shaft. The suction pump has a fine gauze cap to prevent dirt working up into the pump and this is inspected by removing the oil pump. The oil is carried to a sight feed device located over the gear case where the oil flows over the gears and down to the dip pan below the connecting rods and then into the reservoir below. The rods dip at each revolution and throw oil over all the interior, thoroughly lubricating all working parts. A form of piston is used to prevent excessive oil from working over the piston. The surplus oil is scraped down by the lower ring, flowing back through the holes below the lower ring.

The oil sight feed device is comprised of a large glass body so the

PLATE No. 13



LEFT VIEW OF GASOLENE ELECTRIC GENERATOR OUTFIT.

1 Radiator filler cap.
2 Radiator.
3 Radiator support.
4 Generator.
5 Motor generator base.

circulation of the oil can be seen from a distance and from different places on the truck body.

The cooling is by thermo-syphon system, the flow being upward through the straight water pipe connection between the cylinder head and the top of the radiator, then down through the radiator itself and through the jackets of the cylinders.

Gasoline is fed by gravity from the five-gallon cylindrical tank mounted on the rear end of the engine to a float feed carburetor. The carburetor is an auxiliary air valve type. Air enters at the side opposite the float bowl and passes through a venturi containing the needle valve and jet. The primary air passage is supplemented by an auxiliary air valve retained by a spring. The adjustments on the carburetor consist of governing the size of the primary jet by means of the needle valve under the carburetor and also by setting the tension on the auxiliary air valve spring.

TO ADJUST CARBURETOR.

The carburetor is adjusted properly before shipment. If it is necessary, however, to make an adjustment the needle valve at the bottom is turned to the right lightly until the needle valve is seated. Do not do this roughly, or the seat of the needle valve will be damaged. Turn the needle valve back one complete turn and start the engine, allowing it to run slowly. Adjust the needle valve gradually until smooth running is secured. The engine is then increased to high speed and satisfactory operation secured by turning the knurled screw on top of the auxiliary air valve, thus properly adjusting the tension of the spring.

MAGNETO CURRENT.

Ignition is provided by the Bosch high tension magneto type DU-4.

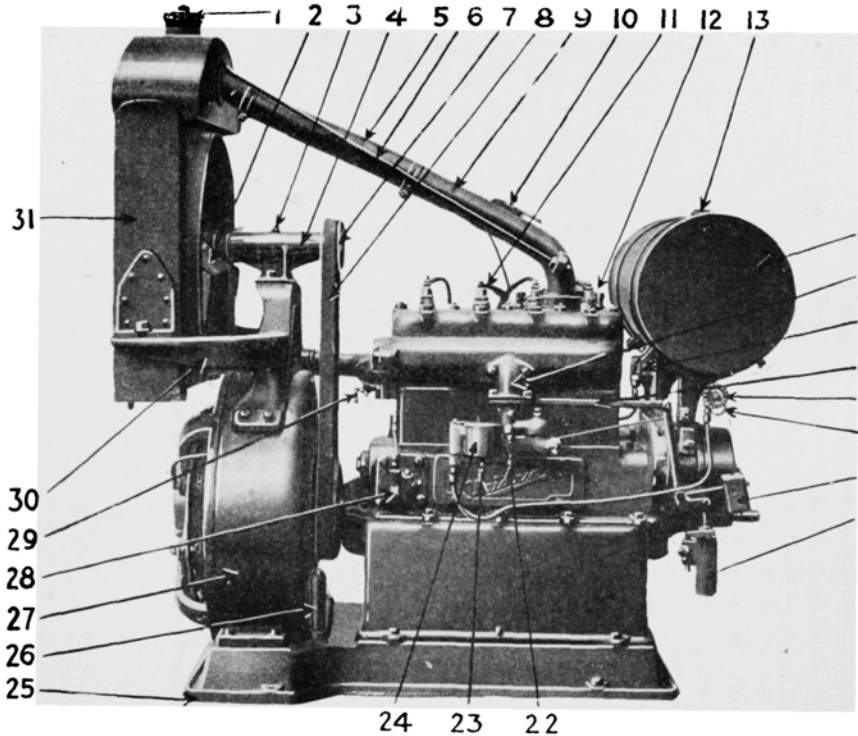
The magneto generates its own high-tension current directly in the magneto armature (the rotating member of the magneto) without the aid of a separate step-up coil, and has its timer and distributer integral.

The armature winding is composed of two sizes of wire, one size comparatively heavy and the other very fine. The heavy wire constitutes the primary or low-tension circuit and the very fine wire the secondary or high-tension circuit.

The rotation of the armature between the poles of strong permanent magnets results in the induction of a current in the armature primary circuit, and this is further augmented at regular intervals in the rotation of the armature shaft by the abrupt interruption of the primary circuit by means of the magneto interrupter. At the opening of the primary circuit the resulting discharge of current from that circuit induces a current of high voltage in the armature secondary circuit. The high-tension current thus created is collected by the slip ring on the armature and passed through the slip-ring brush, then to the various magneto

REAR VIEW OF GASOLENE ELECTRIC GENERATOR OUTFIT.

1 Radiator filler cap.
2 Fan.
3 Fan shaft oil hole plug.
4 Fan shaft bracket.
5 Top water hose.
6 Radiator brace.
7 Fan pulley.
8 Fan belt.
9 Water outlet elbow.
10 Ignition switch.
11 Spark plug.
12 Priming plug.
13 Gasolene filler cap.
14 Gasolene tank.
15 Intake manifold.
16 Valve cover plate.
17 Oil sight feed.
18 Gasolene valve supply.
19 Carbureter air choke rod.
20 Governor weight.
21 Governor weight.
22 Carbureter needle valve.
23 Carbureter drain cock.
24 Carbureter.
25 Motor generator base.
26 Starting crank.
27 Electric generator.
28 Oil pump.
29 Cooling system drain cock.
30 Radiator support.
31 Radiator.



distributor terminals, each of which is connected by cable to the spark plug in its respective cylinder. The operation of the instrument will be more clearly understood from a study of the complete circuits, primary and secondary, which follow.

PRIMARY OR LOW-TENSION CIRCUIT.

The beginning of the armature primary circuit is in metallic contact with the armature core, and the end of the armature primary circuit is connected by means of the interrupter fastening screw to the insulated contact block supporting the long platinum contact on the magneto interrupter. The interrupter lever, carrying a short platinum contact, is mounted on the interrupter disk, which in turn is electrically connected to the armature core. The primary circuit is completed whenever the two platinum interrupter contacts are brought together, and interrupted whenever these contacts are separated. The separation of the platinum contacts is controlled by the action of the interrupter lever as it bears against the steel segments secured to the inner surface of the interrupter housing.

The high-tension current is generated in the secondary circuit only when there is an interruption of the primary circuit, the spark being produced at the instant the platinum interrupter contacts separate.

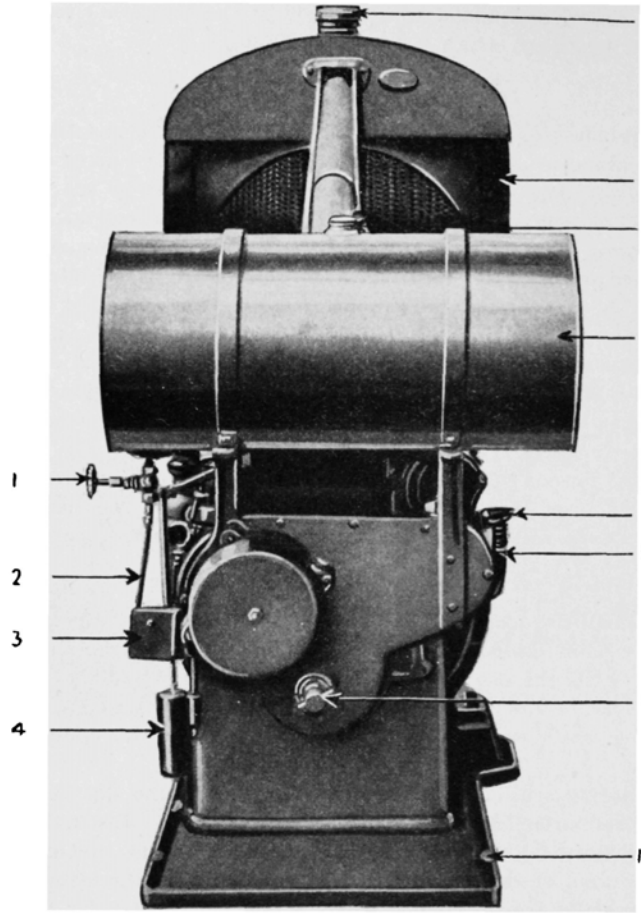
SECONDARY OR HIGH-TENSION CIRCUIT.

The armature secondary circuit is a continuation of the armature primary circuit, the beginning of the secondary being connected to the primary, while the end of the secondary is connected to the insulated current collector ring, or slip ring, mounted on the armature just inside the driving shaft end plate of the magneto. This form applies in all DU types.

The slip-ring brush, which is held in contact with the slip ring by the brush holder at the shaft end of the magneto, receives the high-tension current collected by the slip ring, and, by means of the connecting bar under the arch of the magnets passes the current to the metal contact in the center of the distributor plate. From the latter point the high-tension current passes to the distributor brush, which is held in a brush holder mounted on the distributor gear, and, consequently, rotates with the gear.

Metal segments are imbedded in the distributor plate, and as the distributor brush rotates it makes contact successively with the segments in the distributor plate. The segments in turn are connected with the terminal studs on the face of the distributor plate, and the latter are connected by cables to the spark plugs in the various cylinders. In the cylinders the high-tension current produces a spark which causes ignition and then returns through the engine to the magneto armature, thus completing the circuit.

PLATE No. 15



RIGHT VIEW OF GASOLENE ELECTRIC GENERATOR OUTFIT.

1 Gasolene supply valve.
2 Gasolene pipe.
3 Governor weight.
4 Governor weight.
5 Radiator filler cap.
6 Radiator.
7 Gasolene filler cap.
8 Gasolene tank (5 gal. cap.).
9 Spark control lever.
10 Spark control segment.
11 Starting crank pin.
12 Base.

SAFETY SPARK GAP.

In order to protect the armature and other current-carrying parts a safety spark gap is provided.

Under ordinary conditions, the current will follow its normal path to the spark plug, but if for any reason the electrical resistance in the secondary circuit is increased to a high point—as when a cable becomes disconnected or a spark-plug gap too wide—the high-tension current will discharge across the safety gap.

The current should never be allowed to pass across the safety spark gap for any length of time, and if the engine is operated on a second or auxiliary ignition system the magneto must be grounded in order to prevent the production of high-tension current. The snapping sound by which the passage of the current across the safety gap may be noted should always lead to an immediate search for the cause of the difficulty.

TIMING RANGE.

The magneto interrupter housing is arranged so that it may be rotated through an angle of 35 deg. with respect to the armature shaft. The movement of this housing in one direction or the other causes the interrupter lever to strike the steel segments earlier or later in the revolution of the armature, the spark occurring correspondingly earlier or later in the stroke of the piston.

The spark can be advanced by moving the interrupter housing, by means of the timing-control arm, in the direction opposite the rotation of the armature, and can be retarded by moving the interrupter housing in the same direction as the rotation of the armature. The armature rotation is indicated by the arrow on the oil-well cover at the driving-shaft end of the magneto.

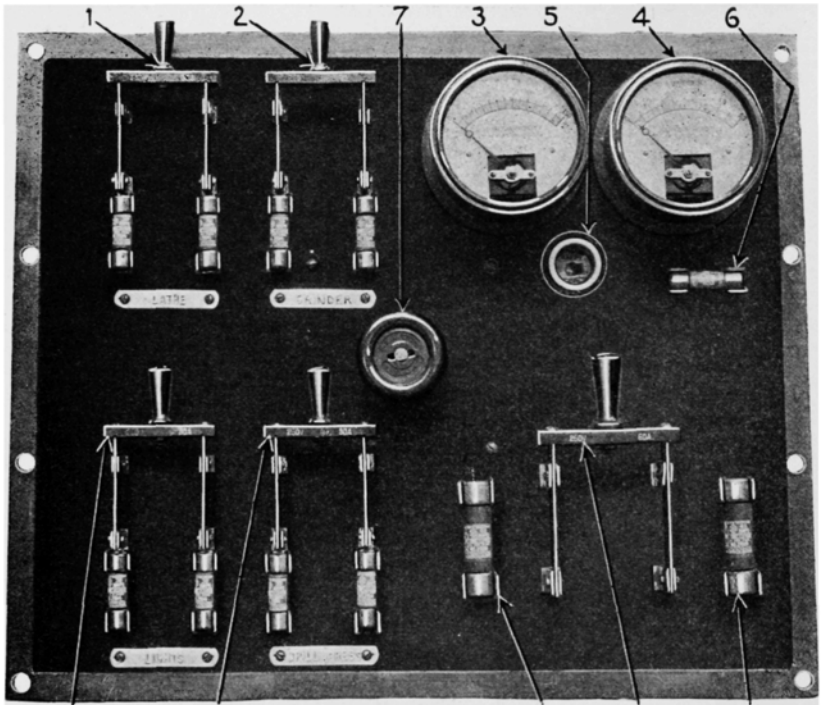
CUTTING OUT THE IGNITION.

Since high-tension current is generated only on the interruption of the primary circuit, it is evident that in order to cut out the ignition it is necessary merely to divert the primary current to a path which is not affected by the action of the magneto interrupter. This is accomplished as follows:

An insulated grounding terminal is provided on the cover of the magneto interrupter housing, with its inner end (consisting of a spring with carbon contact) pressing against the head of the interrupter fastening screw. The outer end of the grounding terminal is connected by low-tension cable to one side of a switch, and the other side of the switch is grounded by connecting another cable between it and the engine or chassis.

When the switch is open the primary current follows its normal path across the platinum interrupter contacts, and is interrupted at each separation of these contacts; however, when the switch is closed, the

PLATE No. 16



SWITCHBOARD.

1 Lathe switch.
2 Grinder switch.
3 Voltmeter.
4 Ammeter.
5 Receptacle for connection to top lights.
6 Voltmeter fuse—3 amps.
7 Regulator.
8 Motor generator switch.
9 Motor generator fuse.
10 Motor generator fuse.
11 Light switch.
12 Drill press switch.

primary current passes from the head of the interrupter fastening screw to the carbon contact of the grounding terminal, thence through the switch to the engine and back to the magneto, and as the primary current remains uninterrupted when following this path no ignition current is produced.

MAGNETO CARE AND MAINTENANCE.

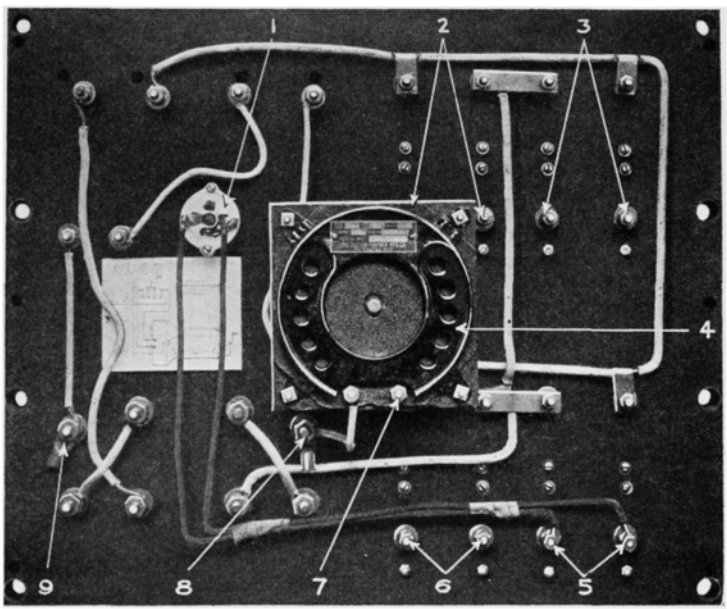
Aside from keeping the magneto clean externally, practically the only care required is the oiling of the bearings; of these, there are two ball

bearings supporting the armature, and in this type with gear-driven distributor a single plain bearing supporting the shaft of the distributor gear.

Any good, light machine oil may be used for this purpose (never cylinder oil), and each of the bearings should receive not more than two or three drops about every 500 miles, applied through the oil ducts under the covers marked "Oil" located at both ends of the magneto.

The interrupter is intended to operate without lubrication, and as oil on the platinum interrupter contacts will prevent good contact, cause sparking and burning, as well as misfiring, care should be exercised to prevent the entrance of oil to these parts.

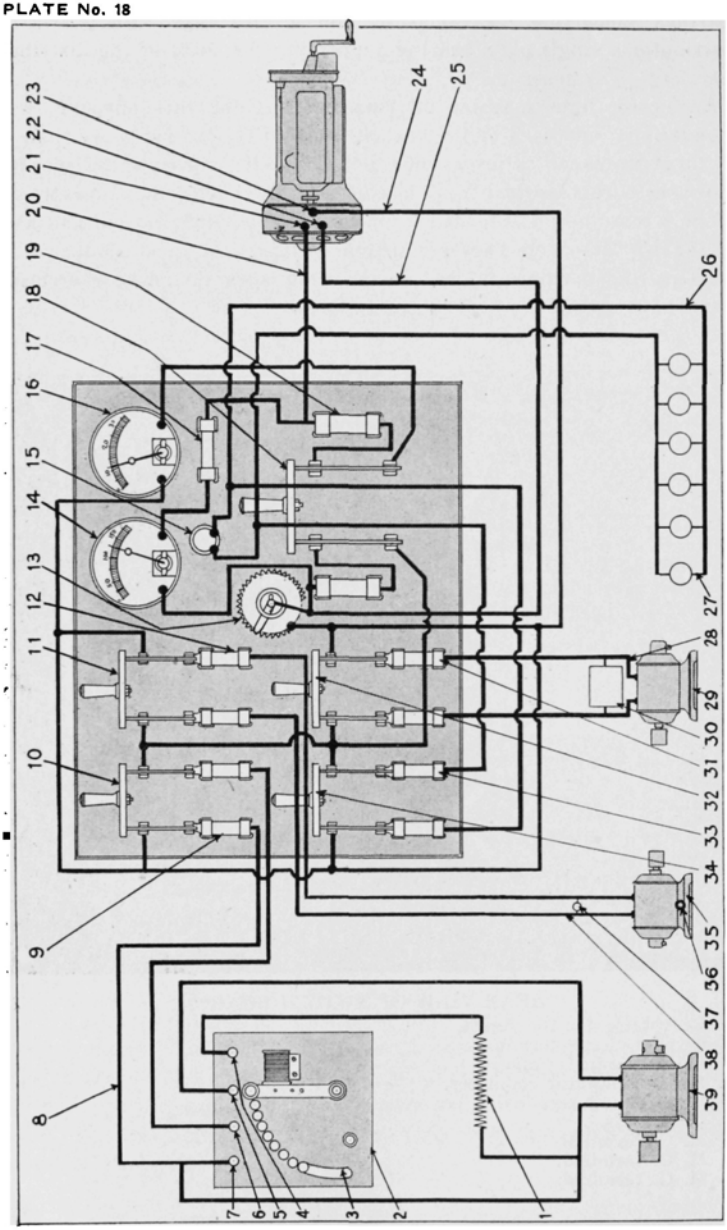
PLATE No. 17



REAR VIEW OF SWITCH BOARD.

1 Receptacle for top lights.
2 Grinder circuit terminals.
3 Lathe circuit terminals.
4 Motor generator regulator.
5 Light circuit terminals.
6 Drill press.
7 M. G. terminal.
8 M. G. terminal.
9 M. G. terminal.

PLATE No. 18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IGNITION TROUBLES.

Ignition difficulties may be divided into two main classes, one, the most common, due to spark plugs and cables, and the other due to the magneto.

In general, when only one cylinder misfires, the fault is in the spark plug, the most common plug difficulties being as follows:

PLUG GAP TOO WIDE.

The distance between the electrodes of the spark plugs varies according to the individuality of the engine, but normally this distance should not be less than 1/50 inch. On the other hand, however, too wide a gap increases the electrical resistance, and interferes with the proper generation of current at low speed. Difficulty in starting an engine, and missing at low speeds, are very often due to the spark-plug gaps being too wide; and, as the spark will have a tendency to burn the electrodes, and thereby gradually increase the gap, it is especially important that the plugs be

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WIRING DIAGRAM.

1 Lathe motor shunt field.
2 Lathe motor starting box.
3 Starting lever "off" position.
4 Field terminal.
5 Armature terminal.
6 Line terminal.
7 Line terminal.
8 No. 12 wire.
9 30 ampere 250 volt fuse.
10 Lathe switch.
11 Grinder switch.
12 30 ampere 250 volt fuse.
13 Generator rheostat.
14 Voltmeter.
15 Receptacle for connection to overhead lamp circuit.
16 Ammeter.
17 3 ampere 250 volt fuse, volt meter
18 Generator main switch.
19 50 ampere 250 volt fuse.
20 No. 4 wire, generator line.
21 Generator negative terminal.
22 Generator positive terminal.
23 Generator field terminal.
24 No. 14 wire generator field line.
25 No. 4 wire generator line.
26 No. 14 wire floor light.
27 Floor light receptacle.
28 No. 12 wire drill press line.
29 Drill press motor.
30 Drill press starting box.
31 30 ampere 250 volt fuse.
32 Drill press switch.
33 30 ampere 250 volt fuse.
34 Light switch.
35 Grinder motor.
36 Snap switch on grinder motor.
37 Receptacle for air compressor.
38 No. 12 wire, grinder and air compressor line.
39 Lathe motor.

examined occasionally for assurance that the gap is not too great; any difficulty due to this cause may be readily overcome by readjusting the electrodes.

PLUG SHORT-CIRCUITED.

This is usually caused by a cracked or porous insulator, or by fouling of the electrodes or insulator. Any of these conditions will cause misfiring by permitting the current to stray from its intended path.

CABLES.

Misfiring of one cylinder, either continuous or intermittent, may be due also to a chafed or broken cable or to a loose cable connection. The cables should be carefully examined, special attention being paid to the insulation. The metal terminals of the cables must not come into contact with any metal parts of the engine or of the magneto, except those designated as being correct according to the instructions given.

IGNITION FAILS SUDDENLY.

A sudden failure of ignition may indicate a short circuit in the low-tension cable, due either to a defect in the cable, to a faulty connection at the switch, or to the presence of dirt or moisture. A test for trouble in the switch or low-tension cable can be made by removing the cable from the grounding terminal on the cover of the magneto interrupter housing and endeavoring to start the engine on the magneto. If the engine runs with this wire disconnected, but stops when the wire is connected, it is evident the magneto is in good order and that the trouble is due to some fault in the switch or grounding wire permitting the low-tension current to escape to ground.

IRREGULAR FIRING.

If the cables and plugs are in good condition, and yet the ignition is irregular, the trouble is probably with the magneto, and the interrupter should be carefully examined. It should be seen that the interrupter lever moves freely on its pivot, that the hexagon-headed fastening screw in the center of the interrupter is properly tightened, and also that the two platinum interrupter contacts are properly secured in position.

If the interrupter lever does not move freely on its pivot, which is sometimes possible, particularly with new magnetos, the hole in the fiber bushing in which the lever pivots may be slightly enlarged by means of a reamer or small round file; this work, however, should be carefully done, as very little reaming accomplishes the desired result.

PLATINUM INTERRUPTER CONTACTS.

The platinum interrupter contacts should be examined for the correctness of their adjustment, and they should be so set that they are separated by a distance of 0.4 of a millimeter (about 1/64 inch) when the interrupter lever is resting on either of the segments in the interrupter

housing. The strip of steel attached to the magneto adjusting wrench drawer No. 11, which is furnished with each magneto, is to be used as a gage for this distance. The adjustment of the platinum interrupter contacts may be made by loosening the lock nut of the long contact screw which passes through the interrupter contact block and turning the hexagon head of the screw itself by means of the before-mentioned adjusting wrench. When the adjustment is made, care should be taken to tighten the lock nut firmly.

The platinum contacts of the interrupter should be clean, and in proper alignment with each other, and any oil, grease or dirt that is deposited on them should be removed. If they are uneven, or in bad condition (but only then), they may be smoothed by means of a fine, flat jeweler's file. The platinum contacts should be kept clean, and in that condition and with proper attention they will last a considerable length of time.

TO REMOVE INTERRUPTER.

The interrupter itself may be taken out as a unit by removing the interrupter housing and withdrawing the hexagon-headed fastening screw in the center of the interrupter by means of the adjusting wrench. Should the interrupter stick on its seat after the fastening screw is withdrawn it may be pried loose by means of two small screwdrivers inserted back of the interrupter disk, one on each side. When replacing the interrupter, care must be taken that the key on the interrupter disk fits exactly into the keyway on the armature shaft.

DAMAGED INSULATING PARTS.

As it sometimes happens that brush holders and other insulating parts of the magneto are damaged through accident or carelessness, these parts should also be carefully examined for possible disarrangement or damage of the insulation which might permit leakage of current.

SUMMARY OF TROUBLES.

In brief, providing the magneto is properly timed to the engine, trouble due to ignition may be as follows:

Engine Will Not Start—Switch closed, switch or switch wire short-circuited, interrupter lever sticks.

Engine Stops Abruptly—Switch closed, switch or switch wire short-circuited; distributer or collector-ring carbon brush broken.

Misfiring at Low Speed—Spark-plug gap too wide.

Misfiring at All Speeds—Defective or dirty spark plug, improper spark-plug gap, cable insulation chafed, cable connections loose, brush holder cracked, platinum interrupter contacts dirty or oily, interrupter lever sticks.

TIMING THE MAGNETO.

With the average four or two-cycle engine the proper operating results are obtained by timing the magneto, as follows:

The crankshaft is rotated to bring the piston of No. 1 cylinder (in this generator set this is the cylinder nearest the radiator) exactly on top dead center of the compression stroke, and the piston is to be maintained in that position. The magneto is then to be secured to its bracket or bed on the engine, and the timing-control arm on the interrupter housing placed in the fully retarded position.

REMOVE DISTRIBUTER PLATE.

With that done, the magneto distributor plate should be removed by withdrawing the two holding screws or depressing the two catch springs, as the case may be, thus exposing the distributor gear and brush. The cover of the magneto interrupter housing is also to be removed to permit observation of the interrupter.

The armature should then be rotated by means of the exposed distributor gear in the direction in which it is to be driven, until the platinum interrupter contacts are just about to separate, which occurs when the interrupter lever begins to bear against one of the steel segments of the interrupter housing.

The armature should be held in that position while the magneto drive is connected to the engine, due care being taken that the piston of No. 1 cylinder is still exactly on top dead center of the compression stroke. The installation is completed by replacing the interrupter housing cover and distributor plate, and connecting the cables between the magneto and spark plugs.

COOLING WATER.

It is of great importance that the water used for cooling purposes is soft, and free from lime or other alkaline substances. Rain water is greatly to be preferred whenever obtainable. In some well water, alkaline substances are deposited when the water becomes heated, and gradually fill up the water jacket until it interferes with the circulation or stops it entirely. Should this ever occur, the deposit may usually be removed by taking off the cylinder head and filling the water jacket and cylinder head with a mixture of No. 8 acetic acid and water, using about one part of acid to one or two parts of water. Allow to stand for a few hours, and drain and wash out thoroughly. This process may be repeated, if necessary.

OILING.

Pour light cylinder No. 3502 oil in the base through the filler hole, watching the oil gage, and feeling the gage indicator at times while filling, to see that it is floating. Pour in oil until the indicator moves up well to the top of the slot. This indicator should always be floating,

and should be worked by hand occasionally to be sure there is oil in the base. The oil is pumped through a tube to the sight feed in front; from here it flows down through the gear case and back into the oil pan below the connecting rods, which has a trough below each rod. The long bolt extending down from each connecting rod dips in this oil and throws it in a mist through the entire inner compartments, completely lubricating all inner working parts. As long as the oil is seen flowing down the sight feed, lubrication is going on properly, but should the oil stop flowing, the cause should be determined at once, to save the possibility of burning out a bearing. Every month, at least, the oil should be drawn off and replaced with fresh.

STARTING.

Before starting, see that the water system is in good working order and that there is a sufficient amount of oil in the base. See that the timer on the ignition is up to give a late or retarded spark, open carburetor needle valve about three-quarter turn, close the choking valve, or hold the hand over the air inlet of the carburetor and turn the starting crank so as to give a quick turn over the top center. It may be necessary to give it several turns to draw in the mixture. The engine will start on the first turn if a little gasoline is poured in the priming cups and drawn into the cylinders by turning the crank slowly. To facilitate starting, especially in cold weather, priming is suggested. The engine runs to the right when facing the crank end. Be sure switch is open.

UNEVEN RUNNING.

After the engine is started the gasoline should be adjusted by closing off as much as possible to give the maximum power. If the engine runs uneven with the carburetor adjusted to the different points, it is most probably due to a defective spark plug. To determine which plug is the cause of the trouble hold a screwdriver across the top of each plug to the cylinder head; when the missing plug is touched there will be no noticeable difference in the running of the engine, but when the working plugs are touched you will notice the result.

FLUCTUATION.

If the governor should fluctuate a little at light load the carburetor can be adjusted to insure even and smooth running. Also see that the dash pot has kerosene or light oil in it.

CHANGE OF SPEED.

The speed is determined by the governor springs. The cap over the governor can be removed and the springs adjusted by stretching or by cutting off a small portion to diminish or increase the speed. A limited change in speed while running can be made by moving the governor weight toward the end of the lever to reduce, or back to increase.

To Stop—Short-circuit the magneto by closing the ignition switch between the binding post on the timer and the ground.

GENERATOR AND GOVERNOR.

The generator is compound wound. The circuit is of 4-Kw. or 4000 watts capacity and operates at 110 volts. Regulation of the current output is secured by governor. This governor is fitted in an oil-tight casing with easily removable cover. In this location it receives oil automatically from the gear case. The speed is maintained at a uniform point by the governor acting on the throttling valve of the carburetor. A weight is provided on the governor lever which can be moved a limited distance along its supporting rod to change the speed to a limited degree. This weight holds the governor parts against lost motion.

A dash pot is provided, with a plunger connected to the governor lever which prevents sudden fluctuation, the same as is used in the large steam engines. This is kept filled with kerosene or light oil and prevents the plunger and lever from suddenly moving from one extreme to the other.

The fact that the governor is inclosed and runs in oil eliminates the trouble of oiling these small parts. In fact, the entire oiling system is automatic, the oil being delivered from the pump to the gear case and governor, thence down into the dip pan below the connecting rods, where each rod dips and splashes oil entirely over its bearings, over the cam shaft and upon the cylinder wall and inside the piston, the piston pin also receiving its share of the splash. The oil then flows down to the reservoir below the pan to be again circulated by the oil pump.

GENERATOR INFORMATION.

Voltage—The voltage is dependent on the speed of the generator. The governor is set for the proper speed to give the full voltage. Should it be desired to increase or decrease the voltage, the speed can be increased or decreased by means of the governor springs, stretching them a little or cutting off a coil. A slight change in voltage can be made by the sliding weight on the governor lever or by the rheostat.

Amperes—The amperes depend on the amount of load on the generator. On the 110-volt generator, 38 amperes gives the full load. Of course, the amperage takes care of itself; the more load the more amperes, until the limit is reached.

Sparking—Sparking at the brushes on light load is harmless, but on heavy load it is liable to gradually burn or heat the commutator bars and connections.

The brushes should fit the commutator perfectly. If this is not the case, or if they touch only at a single point, they should be shaped to fit the surface by drawing a piece of sandpaper between the brush and the commutator with the sand side against the brush. Properly adjusted

brushes will stop sparking, unless the commutator surface is uneven, in which case the commutator can be turned down slightly in a lathe. Sometimes uneven commutator bars can be smoothed down by means of sandpaper or a file. *Do not use emery paper.* All metallic dust must be carefully removed before starting, as this is liable to short-circuit the bars.

A very small amount of vaseline or oil may be used on the commutator, but too much will cause sparking. Sparking may also be caused by a burned-out armature coil.

KEEP ARMATURE CLEAN.

The armature and commutator should be kept clean at all times, and, as a general rule, there is seldom any trouble from the generator, because it is designed to carry an overload greater than the engine will pull, which makes it safe in this respect.

SWITCHBOARD.

The switchboard has the volt and ammeter fully connected and rheostat fitted. The main switch has two fuses of sufficient capacity to carry the load.

TROUBLES AND REMEDIES.

Keep the generator commutator clean by occasionally holding a little smooth, fine sandpaper on it while running.

Failure to Start—Too much or not enough gasoline, usually the latter. Contact points on igniter or magneto may require cleaning.

Other causes of failure to start are magneto interrupter out of adjustment, or contact worn; defective spark plugs or loose wires; or wires leading to the wrong plugs.

Misfiring—Generally caused by defective spark plugs or too much gasoline.

Loss of Power—Too much gasoline, spark not sufficiently advanced, defective spark plug, leaky valves, or worn piston rings.

Look at the sight feed, and see that the oil is flowing to insure proper lubrication.

Loss of Current—Clean commutator on generator as above suggested, and see that all brushes are in contact and fit accurately.

In the 110-volt generator the field current is about 1½ amperes.

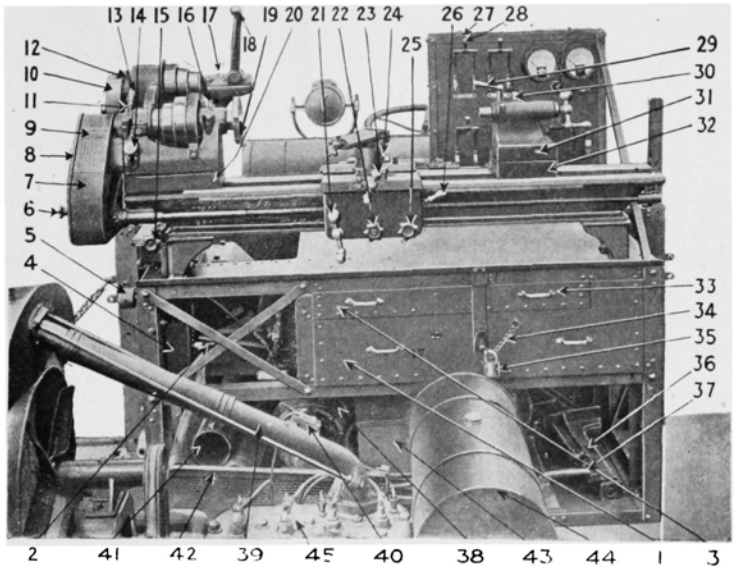
Engine Tight—In case the engine sticks, the trouble is most likely a dry bearing or a bearing that is too tight, either crankshaft or connecting rod, and should be investigated at once. If necessary, scrape the bearing or loosen it slightly. Be sure all nuts on main bearings are locked with spring cotters.

INSTRUMENT LOCATION.

The current from the generator is delivered to a switchboard. This is a master electric control. This board, which is illustrated on page 38,

has a rheostat connected with the fields of the generator governing its output. The master switch is located at the lower right corner of the board and four switches are on the left side controlling current for the motors of the lathe, drill press and grinder and also current for the lighting system. At the top right of the board there is a voltmeter and an ammeter. Beneath the two instruments, the volt meter and ammeter, is a socket in which is plugged the flexible lamp cord connection to the lighting system along the top of the body. There are eleven fuses on the board taking care of the lines controlled by the master and subsidiary switches.

PLATE No. 19



LATHE AND FRAME ARRANGEMENT.

1 Drawer No. 17.
2 Lathe motor starting box handle.
3 Drawer No. 16.
4 Lathe motor starting box.
5 Motor pulley.
6 Guard door knob.
7 Guard frame.
8 Guard door.
9 Index plate.
10 Counter shaft pulley.
11 Spring oiler.
12 Spring oiler.
13 Back gear lever.
14 Feed lever.
15 Belt tightener knob (counter shaft to lathe).
16 Spring oiler.
17 Spring oiler.
18 Countershaft clutch handle.
19 Small face plate.
20 Head stock block, 2 in. high.
21 Feed screw hand crank.
22 Friction stem knob.
23 Cross slide screw crank.
24 Compound rest block, 2 in. high.
25 Change feed tumbler knob.
26 Clamp nut lever (open position).
27 Switchboard.
28 Lathe knife switch.
29 Spindle clamp, tailstock.
30 Binder bolt nut.
31 Tailstock adjusting screw.
32 Tailstock block, 2 in. high.
33 Drawer handle.
34 Chain for lock.
35 Lock.
36 Jack.
37 Air compressor handle.
38 Air compressor motor, 1½ h.p.
39 Motor generator cylinder water outlet elbow.
40 Motor generator ignition switch.
41 Stove pipe.
42 Motor generator guard.
43 Air compressor tool box.
44 Motor generator gasolene tank.
45 Cylinder head.

CHAPTER 4.

LATHE AND LATHE EQUIPMENT.

GENERAL SPECIFICATIONS.

Lathe rating	9 in.
Lathe drive	electric motor
Method of drive	belt
Speed control	rheostat
Regular change gears	11

LATHE FITTINGS AND EQUIPMENT.

The lathe is a nine-inch Star screw cutting type made by the Seneca Falls Manufacturing Co. It is fitted with two bench legs and a small face plate. The lathe is connected to the motor through a counter shaft attached to the lathe bed. The drives are taken through two belts, one from the motor to the counter shaft, and one belt from the counter shaft to the headstock. The belts are laced by patent hinged-type lacing. Included in the equipment are attachments of the widely varied nature which are given in the list herewith. Some of the more important fittings include two-inch blocks for the headstock, tail stock, and straight tool post. There is a taper attachment, bushings for drawing in chuck in headstock and a rheostat bolted to the inside left side of the lathe frame.

The change gears include eleven regular gears, one extra 45-tooth gear, one extra 80-tooth gear. A complete set of wrenches is furnished and the locations are given in the list of lathe equipment on page 62.

LATHE DESCRIPTION.

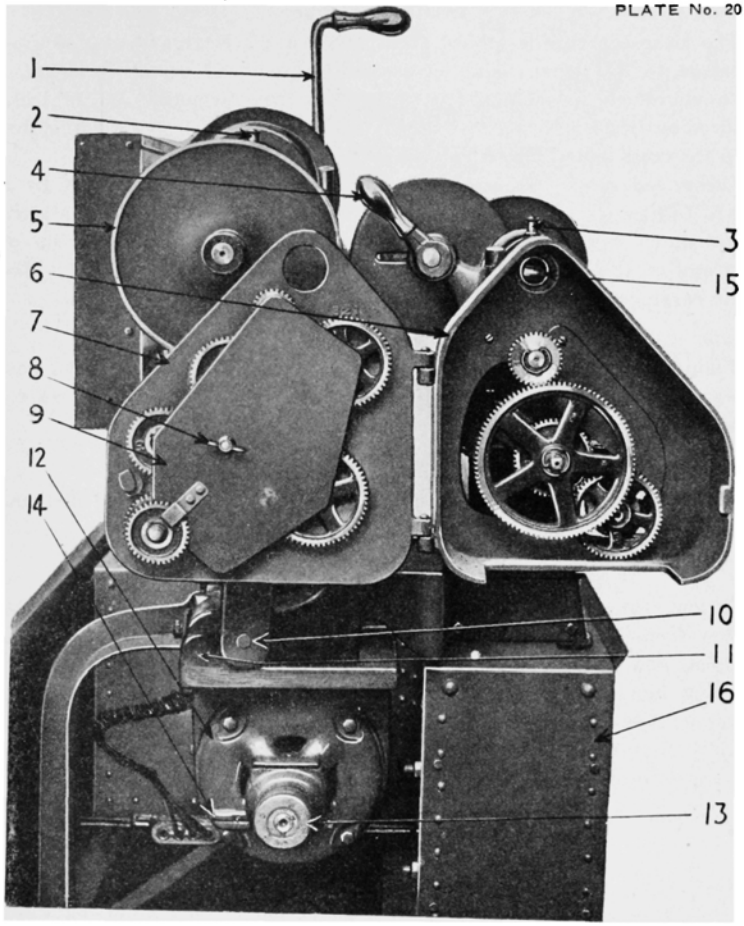
The lathe is arranged for motor drive, the motor being mounted in the lathe frame. There is a complete set of attachments, as indicated in the above list, and the following few notes give additional details on the construction.

LATHE HEADSTOCK.

The lathe headstock is a web pattern, hollow spindle made from 60-65 carbon crucible steel, accurately ground to size, revolving in ample hand-scraped ring-oiling bearings, nose is threaded part way only to facilitate changing chucks and face plates without damaging threads and to insure perfect fit.

All spindles have large hole suitable for draw-in chuck. Cone is finished inside and outside, balanced for high speeds, is locked to head-gear by push-pin, and may be secured or released without using wrench, all gears are guarded.

PLATE No. 20



LATHE—LEFT END WITH GUARD DOOR OPEN.

1 Counter shaft clutch lever.
2 Spring oiler.
3 Spring oiler.
4 Back gear lever.
5 Counter shaft pulley.
6 Guard frame.
7 Guard door.
8 Shield wing nut.
9 Change gear shield.
10 Counter shaft pivot.
11 Motor base pivot.
12 Lathe motor.
13 Lathe motor pulley.
14 Oil cup, hinged cover.
15 Hollow spindle.
16 Lathe frame.

LATHE CARRIAGE.

The lathe carriage is gibbed front and rear; a locking device secures carriage to bed when using cross-feed. Cross-feed screw is supplied with micrometer collar graduated to read in thousandths of an inch, secured by friction spring and readily set to any position. An adjustable stop for cross slide is provided for screw-cutting, etc.

Cross-feed screw and ways are protected from chips and dirt by a guard full length of slide. The carriages are arranged for taper attachment which can be affixed. There are four 7/16-in. holes in top of carriage of the lathe for clamping work. T-slots are provided on the lathe carriages.

RESTS.

Plain and compound rests interchange, one cross slide and tool post answering for both rests; a binding device facilitates changes and rigidly binds either rest to cross slide, which is graduated 180 degrees.

TOOL POST.

The tool post has patented collar and shoe, which exclude all dirt and chips, and admits of adjustment of tool.

FEEDS.

Power cross and longitudinal feeds are actuated by worm, receiving power from head spindle through spur gears and lead screw, which is splined, and acts as a feed rod. Feeds may be thrown in or out by turning hand knob on apron, which operates friction clutch, shifting reverse lever in headstock will feed in or out, right or left, or throw entirely out of engagement. The automatic power cross-feed is for accurate results and smooth surfaces when facing and other similar service.

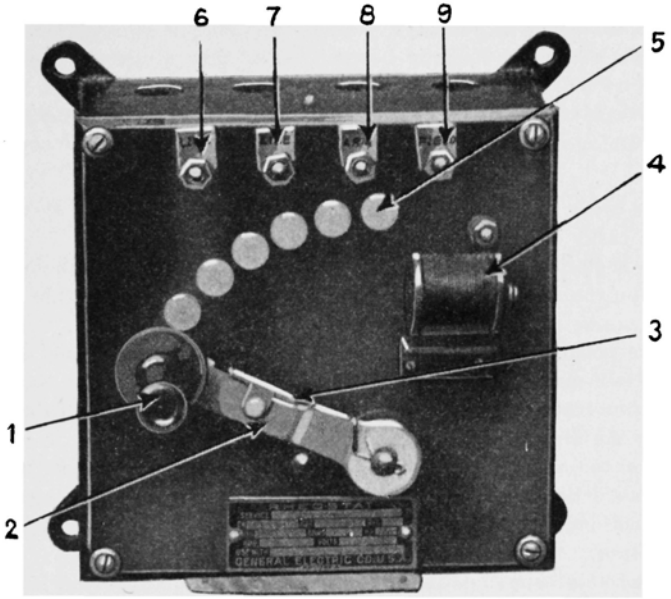
SCREW CUTTING.

Range, all standard threads, right and left from 3 to 72 per inch, including 11½ and 27. Transposing gears and index for cutting International Standard Metric threads from 0.5 mm. to 8 mm. pitch are carried in drawer No. 17.

DETACHED PARTS.

Each lathe is furnished with both large and small face plates, center rest, follow rest, two point centers hardened and ground, center oiler, full set of change gears and drop forged tool-post wrench. All gears are guarded. The door of change gear guard has pegs for holding loose gears. Change gears have rounded edges to avoid injury to hands. Split spring washers hold change gears in place and facilitate quick shifting. All adjusting screws have uniform size heads to fit tool-post wrench. Screws, nuts and small parts liable to become bruised are case-hardened.

PLATE No. 21



LATHE MOTOR STARTING BOX.

1 Lever handle.
2 Lever.
3 Magnet shoe.
4 Magnet.
5 Running position.
6 Line terminal.
7 Line terminal.
8 Armature terminal.
9 Field terminal.

OILING THE LATHE.

Oil every place provided for oiling.

Use nothing but a light machine oil.

Oil frequently. If the lathe is not in constant use, oil every time before using.

Study the machine carefully, so as to find all the places to oil; and then omit none of them in oiling.

The ways on which the carriage runs should be oiled on top and below by putting a little oil on the fingers and rubbing it on.

Do not forget to oil the under side of the ways at the back, where the gib holding the carriage down bears. If this is omitted the carriage will run hard and the ways may be cut.

The screw operating the tail spindle should be oiled occasionally by running the spindle clear out, taking it out of the tail stock and oiling the collar nut in the end.

The bearings of the little reversing gears in the head are likely to be forgotten and cause trouble by the lack of oil.

The bearing of the cone pulley on the spindle can be oiled by taking out the proper screws in the steps of cone.

A little oil used frequently is much better than a quantity used more seldom.

All excess of oil should be wiped off before using the machine, as any oil remaining outside the bearings only serves to catch the dust and chips.

CLEANING THE LATHE.

After using the lathe it should be wiped off with a cloth or waste, as it is most easily cleaned at this time.

If by neglect the ways become gummed with oil and dirt, one must rely wholly on the solvent action of kerosene or gasoline to loosen the film so that it can be rubbed off.

If the polished surfaces other than the wearing surfaces get stained, emery cloth may be used for cleaning, but the surfaces should be rubbed only in the direction in which they were originally finished. This can be seen by the direction in which the grain of the finish runs. *Never use emery on the wearing surfaces.* After cleaning any surfaces with emery they should be washed thoroughly with gasoline to remove emery, and lubricated immediately in order to prevent rust, as the emery scores the surface.

After the lathe is oiled the belt may be put on, and it is very desirable not to have it too tight, as a tight belt causes much unnecessary friction and consequently makes the lathe run hard.

STARTING THE LATHE.

Before starting the lathe for the first time under power, look carefully at the following points:

Examine the "back gears" and see whether or not they are in mesh. If they are, the cone lock pin must be pulled out to stop. If this is not done, the lathe will not run. If the back gears are out of mesh, see that the cone lock pin is adjusted to lock the cone to the head gear, as otherwise the cone will simply revolve without turning the spindle or work.

Have the feed lever in its midde position, so the feed gears are stationary, until you are certain of the proper operation and adjustment of the back gears.

PUTTING IN FEED GEARS.

Before moving the feed lever be sure that all the feeds on the apron are thrown out so that the lead screw can be turned easily by hand. The feed lever can now be thrown down (*with the lathe stopped*), and on starting the lathe the screw will be turning. By raising the lever to its highest position the screw will turn in the reverse direction.

THROWING IN THE FEEDS.

Turning the knurled handle will connect the friction feed used for turning. If the carriage does not move in the proper direction, change it by moving the feed lever.

Loosening the handle and lowering it will connect the automatic cross-feed, which may be stopped and started by the use of the proper handle.

Be sure that the friction feed handle is off, and then try the clamp nut. This is used in thread-cutting only, and must *never* be thrown in with any other feed or the carriage locked to bed. If it is, something *must break.*

ADJUSTING GEARS.

When setting up the gears for screw-cutting or feeding, be sure to leave a little slack between the teeth, for if they are crowded closely together it makes the gears run hard, and any particle of dirt getting in will have a tendency to break the teeth.

ADJUSTING GIBS ON THE SLIDES.

When it is necessary to tighten up the gibs on the slides it is a good plan to tighten up the first screw so tight that it binds, then slack it up a very little, and treat the next screw in the same way; by following this plan each screw will have the same tension and the gib will bear evenly its whole length.

TURNING TOOLS.

These tools come properly ground, and in sharpening every effort should be made to preserve the cutting angles as they are when the tool is new. Much difficulty will be avoided by following the hints on grinding given here. The SIDE TOOLS should be ground only on the TOP and FRONT END. If a burr is thrown up on the side when you grind the top, this burr should be removed on the OIL STONE, and NOT GROUND.

The Diamond Point is to be ground on the TOP and FRONT; the caution as to maintaining the original angles is especially applicable to this tool. For taking a finishing cut, the point of this tool should not be V-shaped and come to a point, but should have the extreme point flattened off so that it is about a thirty-second of an inch wide. In setting this tool, to insure easy cutting, the point should be set as far above the center as the diameter of the work will admit. For work one-eighth to one-fourth of an inch in diameter, the point must be set nearly or quite on the center. But for work, say six inches in diameter, the cutting point should be set one-fourth or three-eighths above.

THE SIDE TOOL.

Is to be set with the straight side nearly parallel to the face of the work, but since the side is not exactly straight, the tool should be set so that about one-eighth of an inch at the point is all that is cutting. This tool is to be used by starting at the center of the piece and working toward the outside. The point of the tool should be of sufficiently acute angle that the tool may be pressed in close to the dead center, with the point of the tool touching the work and the center at the same time. In order to remove the burr from the center of the piece, one can slack up

the dead center slightly, and then feed the tool forward, so that the point will project over the edge of the countersink, which will be exposed by slacking up the center. *Be careful not to slack up the center too much, or to let the tool catch in the work.*

THE CUTTING OFF OR PARTING TOOL.

This tool is to be ground only on the front end, and the clearance angle maintained as it is when the tool is new. Care must be used in setting the tool, so that the sides of the cutting part do not rub on the sides of the cut. The top surface of the tool should be set at the height of the center, and if, in cutting, the tool seems to ride and glaze the surface, with also a tendency to dig in, look carefully to the height of the tool, and the probabilities are that you will find it too high. Lard oil is to be used as a lubricant when cutting steel with this tool, but brass and cast iron are cut dry.

THE THREAD TOOL.

Good threads depend to a great extent on the thread tool being in good condition. This means that the angle of the tool should be exactly that required by the thread. Sixty degrees is correct for U. S. S. threads, and 55 degrees for Whitworth threads. These angles can best be determined by the use of a Center Gage, which is provided with notches of the proper angle, and which also serves to assist in setting the tool with the center line of the angle perpendicular to the axis of the piece. The catalogue of the makers shows the method of using the gage. The height of the tool is to be adjusted so that the top of the tool is the same height as the center.

THE BORING TOOL.

Is to be ground on the front and set as *low* as possible without having the lower part scrape on the hole. Run the tool in the whole depth of the hole before trying to cut, so as to be sure that the shank does not touch.

SHARPENING TOOLS TO CUT BRASS.

No tool that has top rake should be used on brass, since these tools have a tendency to dig into the work. On this account the side tool and diamond point are not suited to cutting brass, but a flat-topped tool, similar in shape to the thread tool, will be found most convenient.

TYPICAL OPERATIONS.

TURNING ON CENTERS.

Have the piece of stock as nearly the right length as you can, cutting it from the bar, if possible, with a hack-saw, so as to leave the ends reasonably flat. If the bar is one-half inch or smaller it may be passed through the spindle of the lathe and held in the chuck, and then cut off with the cutting-off tool. In this case it will only be necessary to leave the piece about a thirty-second part of an inch longer than the

finished length. With a pair of dividers find the center of the end of the piece and mark the place with a prick punch. Then mount the piece between the centers of the lathe and spin it rapidly with the fingers of one hand, while the other holds a piece of chalk lightly in contact with the piece. This will show whether or not the trial centers are correctly placed, and if not, they can be shifted by slanting the prick punch toward the side that the chalk has marked, and driving it over a little and then straighten up the punch and strike a few blows to make the mark round, and then try the piece again in the lathe. Repeat the operation until the piece runs true; it is better to have the piece run quite true, even if there is plenty of stock on it, as the turning would much more apt to be true if the stock is uniform than it is where it is irregular. Having found the center with sufficient accuracy, drill and countersink the centers, preferably with a combination center drill. Do not make the centers too large; one-sixteenth of an inch is big enough for most work less than an inch in diameter, and for larger work, if the centers are about one-eighth, they will be about right. Always countersink centers.

With the side tool face up one end, taking off about half the excess of stock left in cutting off, then face the other end to the proper length. One thing to be borne in mind is that at this stage the piece is to be of the *finished length,* the exceptions to this rule are very few and seldom met.

With the cutting-off tool make cuts in the piece to locate whatever shoulders there are to be made. A little judgment must be used in applying this rule, as it would not be advisable to make a cut with the parting tool in the center of the length, as the cut might so weaken the work that the other cuts could not be taken. The object of using the parting tool in this way is to clear the corner of the diamond point so that at the end of the cut the corner of the tool will not dig in and bend or otherwise spoil the work. From this it will be seen that if the shoulder is very slight, it may not be necessary to use the parting tool.

In setting the parting tool it is well to leave about a sixty-fourth of an inch, to be faced off with the side tool afterward, and also to leave the same amount in excess of the finished diameter.

The diamond point is the tool to use for taking off the heavy chips, if the piece is steel or wrought iron, and the round-nosed tool is right for this work in cast iron.

In calipering the piece while taking these roughing cuts, set the calipers to the diameter that you wish to turn, and make the piece of such size that the calipers just touch—not go over by the application of appreciable force. Having roughed out the entire piece, we can start with the finishing, remembering to finish the least important thing first. In finding the finished size, cut and try on the piece for a short distance

at one end, and having determined the proper size at that point, let the cut run right across the length to be turned of that diameter. The hints given under the heading of the diamond point will apply in making the tool cut smoothly for a finishing chip. A fine feed is not at all necessary in order to produce smooth work if the tool is properly set and ground. A fine feed is only to be used where the work is so small that it is not stiff enough to stand a coarse feed.

SETTING THE LATHE TO TURN STRAIGHT.

Several methods might be given for making this adjustment, but perhaps the simplest one is as follows:

Put any piece of stock that has good centers in the lathe, and put in a diamond point and raise it up very high, so it will not cut, but just rub, against the piece. Twirl the piece with the fingers, as was done with the trial centering, and screw the tool in until it binds the pieces slightly. Then take the piece out of the lathe and run the tool along to the other end, and put in the piece again with the ends reversed. Try the tool and piece together again and see if the tool rubs just the same at the same place as it did before. If the tool does not touch or bears harder than it did, the screws at the side of the foot-stock are to be turned so as to move the upper part of the stock in the right direction, and then repeat the testing until the adjustment is correct.

Sometimes we find that, in turning a piece where the cuts taken from each end come together in the middle, they do not match, although the diameters caliper the same. This is caused by dirt or grit in the center hole, which should be carefully wiped out, or the live center not running true; and truing up the center with a tool will overcome the difficulty.

TAPER TURNING.

Tapers should be turned by the use of the taper attachment with which the lathe is equipped, altho they may be turned by setting over the foot stock to the desired position. Without the attachment the final adjustment of the foot stock is a cut-and-try matter, where accurate results are necessary; but we can approximate very closely by a little calculation, and so reduce the number of trials to those needed for the final adjustment. If the taper is given as so much per foot, we would find how much taper there would be in our piece if the taper ran the whole length, by making this proposition:

Twelve inches $\div$ taper per foot = length of piece $\div$ taper. Having found the total amount of taper in this way, we move the foot stock one-half the amount of the taper as found above. The amount of set-over depends only upon the taper per foot and the length of the piece, and is independent of the length of the tapered part of the piece.

If the taper is to be copied from a sample, we are to measure the

sample at two points, a known distance apart, and from this find the taper per foot for use as above.

Tapers that are steep enough to require the use of the compound rest are generally given in degrees which makes the setting of the rest very simple, as it is graduated and the degrees can be read off directly. It is to be remembered that the rest graduations read O when the tool moves perpendicular to the axis of the work, and if the angle given on the drawing is measured from the axis, the setting for the rest will be the difference between 90 degrees and the given angle.

Tapers that are required to fit taper sockets must, for the final adjustment, as indicated above, be tried in the place they are to go. Three or four light chalk marks running the length of the taper, when tried in the socket will show where the contact is, and the adjustment may be made accordingly. For very nice fitting a light coat of bearing blue (such as the artists use) is better than chalk.

CHUCK WORK.

In using the universal chuck one must not expect that one screw will operate the chuck so as to hold the piece firmly. To be sure, one screw does move all the jaws, but after tightening one screw enough to hold the piece from dropping out, one ought to tighten up the next screw a little and then the next. It will be found that the first screw can now be tightened a little more quite easily, and *this process is to be repeated several times,* until the jaws are all as tight as is necessary. In loosening the chuck the same process is to be followed. This method insures that the mechanism of the chuck will not be damaged by overstraining in tightening. Never use any other wrench in operating a chuck than the one furnished with it. By following this plan all damage of the chuck screws will be avoided.

If it is required to set up a piece of stock to run true in an independent chuck, we can grasp the pieces in the jaws, and by observing the direction of the greatest eccentricity we can roughly center the piece by loosening one jaw and tightening the others. Having the piece nearly true, we can hold a piece of chalk near the revolving work and the chalk mark will be on the side of the work that is too far from the center, so that we must move the jaws so as to move the piece away from the chalk-marked side. If the piece does not have the same eccentricity at both ends, we can tap it with a hammer until it remains parallel to itself while it is revolving, and then correct the eccentricity as directed before.

If a hole is to be drilled in the end of a piece held in the chuck, we must make a countersink for starting the drill with the centering tool, as was directed in describing that tool. Make the countersink of about the size and angle of the point of the drill; this will almost insure that the drill will start true in the work. If it is necessary for the drill

to run very true, it will be a good plan to start the drill in the countersink until it cuts nearly its full size, and then true up the hole again with the centering tool, being very careful to keep the proper angle that matches the drill.

In drilling, the drill is kept from turning by a dog put on the shank, if the drill is large; or, if the drill is small, it may be held in a chuck which fits the foot-stock spindle. In either case the drill is fed forward by the foot-stock screw.

For drilling out a hole that has already been cored, a twist drill is not very well suited; a flat or a four-lip drill is very much better. The flat drill is held in a holder which goes in the tool-post and which must be adjusted in height to be the same as the center. A little strain is put upon the drill with a wrench and the drill fed forward, being careful that the drill does not come off the dead center.

Drilled holes are generally not good enough for holes in wheels and gears that have to be fitted to shafts, but after the holes have been drilled they should be reamed with a reamer which leaves the hole more nearly round than the drill does. Use smaller drill to start, for accuracy.

SCREW CUTTING.

The lathes are provided with an index, giving the proper gears for cutting a wide range of threads in most general use. The term "Stud" used in connection with the gears and index refers to the place for the upper change gear of the screw-cutting train.

"Screw" means the end of the lead screw. When the number of threads to be cut is not found on the index, we suggest the following rule, which in this form will apply only to these lathes:

Make a fraction having the turns per inch of the required screw as the numerator, and 12 (the pitch to which the lead screw is geared) as the denominator. Reduce this fraction to its lowest terms; the result will be the ratio of the required gears. Multiply both terms of this ratio by some multiple of six; this gives two gears that will do the work. If these gears are not both in stock, try another multiple of six as a multiplier, and so on until satisfied that no pair of stock gears will suit. In this case another gear will have to be procured. Any of the fractions found as above that gives *one* gear that is in stock will have as its other term the gear necessary as a mate.

The washers that hold the change gears in place are slotted on one side, so that when the knurled sleeve is pulled out the washer will turn and fall off; the required change is made by slipping proper gears over sleeve to correct position on stud. When replacing washer, be sure the flat side goes next the gear.

If the original ratio is less than one, the smaller gear goes on the screw; if the ratio is greater than one, the larger gear goes on the screw.

First, set the compound rest at one-half the angle of the thread. The grinding and setting of the thread tool have been dealt with in a previous paragraph. After the gears have been put on and the tool properly set, we can cut the thread. The clamp nut lever at the right of the apron should be pressed down to connect the carriage directly with the lead screw; *other feeds all off*. The stop on the cross slide is to be set so that the point of the tool just touches the work when the slide is against the stop. Take very light cuts over the work and withdraw the tool at the end of each cut before running the tool back.

Generally the best way to get the tool back to the starting point is to run the lathe backward; but if the piece is large, so that it must turn slowly, or is very long, a good deal of time can be saved by stopping the lathe, opening the split nut and moving the carriage back a whole number of inches by hand and then closing the nut for another cut.

The thread is to be cut till it fits whatever nut is taken as a standard. Be sure that the tops of the threads never become sharp; if they get sharp before they will go into the nut, the extreme points must be taken off with a fine file.

THE COUNTERSHAFT.

In setting up the countershaft, be sure there is a little (one-sixteenth of an inch) end play between the shaft and hangers. This insures free running and a good distribution of oil from the self-oiling boxes. These hanger boxes, when once filled with clean oil, will not need attention for a long time. When it is necessary to drain the oil wells, the small screws in the bottom of the bearings may be removed to allow the oil to run out.

The pulleys and clutch fork should be oiled frequently, a little at short intervals being better in these places than a larger quantity more seldom.

If the clutches slip they may be tightened by moving the adjusting screw shown in the end of the clutch lever in the illustration. Care must be used not to tighten the clutch so much that the lever will not ride up onto the straight part of the cone without the application of too much force to the shipper. If the lever does not go up onto the cylindrical part of the clutch cone, the clutch will not remain engaged when thrown in by the movement of the shipper.

Be sure to tighten the lock nut on the adjusting screw after making the adjustment.

TOOL POST GRINDER.

A tool post grinder is supplied and is carried in drawer No. 15. It is operated by a type P, Cincinnati ¼ horsepower motor, operating on 110 volts D.C. It is fitted with two wheels, one 4½ in. in diameter with a ⅜-in. face for exterior grinding and one 1½-in. wheel for internal grinding. These wheels are both Norton Alundum grain 3860 grade N. In the equipment of the tool post grinder there is one extension mandrel, one tooth wrench, one shank, ⅝ x 1 x 4½ in., and a conductor table to plug in for operating the grinder.

LIST OF LATHE EQUIPMENT.

Name of piece.	Location on truck.
Bushing, expansion for taper mandrels	Drawer No. 8
Cutters, side milling, ¼ in	Drawer No. 12
Cutters, side milling, 5/16 in	Drawer No. 12
Cutters, side milling, ⅜ in	Drawer No. 12
Cutters, side milling, 7/16 in	Drawer No. 12
Cutters, side milling, ½ in	Drawer No. 12
Cutters, milling, 45 deg. angle, r.h., ½ x 2½ x ⅞ in	Drawer No. 12
Cutters, milling, 45 deg. angle, l.h., ½ x 2½ x ⅞ in	Drawer No. 12
Cutters, milling, convex, carbon steel, ⅛ in	Drawer No. 12
Cutters, milling, convex, carbon steel, ¼ in	Drawer No. 12
Cutters, milling, convex, carbon steel, ⅜ in	Drawer No. 12
Cutters, milling, convex, carbon steel, ½ in	Drawer No. 12
Cutters, milling, 60 deg. double angle, ½ x 2½ x ⅞ in	Drawer No. 12
Cutters, slitting, 1/32 x 2½ x ⅞ in. hole. P. & W	Drawer No. 12
Cutters, slitting, 3/64 x 2½ x ⅞ in. hole	Drawer No. 12
Cutters, slitting, 1/16 x 2½ x ⅞ in. hole	Drawer No. 12
Cutters, slitting, 3/32 x 2½ x ⅞ in. hole	Drawer No. 12
Cutters, slitting, ⅛ x 2½ x ⅞ in. hole	Drawer No. 12
Cutters, slitting, 5/32 x 2½ x ⅞ in. hole	Drawer No. 12
Cutters, threading, single point, U. S. form thread	Drawer No. 8
Dogs, lathe, clamp, 1¾ in., No. 11	Drawer No. 16
Dogs, lathe, clamp, 2¾ in., No. 13	Drawer No. 16
Gauge, center, No. 390 Starrett	Drawer No. 1
Gauge, micrometer, depth, No. 446-A	Drawer No. 1
Gauge, screw threading tool, 29 deg., No. 715	Drawer No. 1
Gauge, worm thread, No. 720	Drawer No. 1
Gauge, V-thread, screw pitch, No. 436	Drawer No. 1
Gauge, Universal, surface, with 9-in. spindle	Drawer No. 1
Grinder, tool post, type "P"	Drawer No. 15
Holder, boring tool, "Agrippa," No. 80	Drawer No. 8
Holder, cutting off tool	Drawer No. 8
Holder, cutting off tool	Drawer No. 8
Holder, cutting off tool	Drawer No. 8
Holder, side tool	Drawer No. 8
Holder, threading tool	Drawer No. 8
Holder, turning tool, No. OS, ⅜ x ⅞ x 5 in	Drawer No. 8
Holder, turning tool, No. OR, "Agrippa," ⅜ x ⅞ x 5½ in.	Drawer No. 8
Holder, turning tool, No. OL, ⅜ x ⅞ x 5½ in	Drawer No. 8
Indicator test, No. 64, Starrett, Universal	Drawer No. 1
Lathe, No. 20, "Star," 9 in	On body platform
Lathe, 1—Block 2 in. for straight tool post	Drawer No. 16
Lathe, 2—Bolts, steady rest (spare)	Drawer No. 16
Lathe, 1—Bolt, steady rest with blocking	Drawer No. 16

Name of piece.	Location on truck.
Lathe, 4—Centers, point No. 2 Morse	Drawer No. 16
Lathe, 1—Chart, metric gear change	Drawer No. 17
Lathe, 1—Chart, milling and gear cutting attachment	Drawer No. 17
Lathe, 1—Chuck "Draw-in"	Drawer No. 17
Lathe, 1—Clamp, for steady rest	Drawer No. 17
Lathe, 10—Collets No. 2, split, 1/8, 5/32, 3/16, 7/32, 1/4, 9/32, 5/16, 3/8, 7/16, 1/2	Drawer No. 8
Lathe, 1—Dog lathe center	Drawer No. 17
Lathe, 1—Gears, metric transposing	Drawer No. 17
Lathe, 11—Gears, regular set	Drawer No. 17
Lathe, 1—Gear, 45 tooth	Drawer No. 17
Lathe, 1—Gear, 80 tooth	Drawer No. 17
Lathe, 1—Guard, spindle	Drawer No. 16
Lathe, 1—Milling and gear cutting attachment 593 consists of:	
1 Vertical slide column	Drawer No. 17
1 Clamp for vertical slide column	Drawer No. 17
1 Clamp for bar support	Drawer No. 17
1 Crank for vertical column	Drawer No. 17
1 Crank—dividing head	Drawer No. 17
1 Cutter—block with shaft and collar	Drawer No. 17
1 Dividing head	Drawer No. 17
1 Overhanging—bar with tail center	Drawer No. 17
1 Support—overhanging bar	Drawer No. 17
1 Vise—milling	Drawer No. 17
Lathe, 1—Motor G.E., shunt wound, 3/4 H.P., 115 volt D.C., with CR 1000 rheostat	Mounted on lathe
Lathe, 1—Plate, face, 9 in	Drawer No. 16
Lathe, 1—Post, tool, straight, including:	
1 Washer	Drawer No. 16
1 Rocker	Drawer No. 16
1 Screw	Drawer No. 16
1 Wrench	Drawer No. 16
Lathe, 1—Rest, follow	Drawer No. 16
Lathe, 1—Rest, steady	Drawer No. 17
Lathe, 1—Sleeve, lathe center	Drawer No. 16
Lathe, 1—Wrench, tail stock	Drawer No. 16
Mandrels, taper, Nos. 3 to 9 inclusive	Drawer No. 8
Mills, end, spiral, No. 1, Morse taper	Drawer No. 8
Mills, end, spiral, No. 2, Morse taper	Drawer No. 8
Wheel, Norton Alundum, 4½ x 3/8 in	Drawer No. 15
Wheel, Norton Alundum, 1½ x 3/8 in	Drawer No. 15

PLATE No. 22