DRAFT

Manual of

Pyle-National Steam Locomotive Headlighting Equipment

Contents

Source	Description	Date of Issue	Section
Pyle-National Co	"K" and "K2" Headlight Equipment		Appendix A
Pyle-National Co	List of Parts for Type "K" Headlight Equipment		Appendix B
Pyle-National Co	Bulletin 193 (re K240)	June 1937	Appendix C
Pyle-National Co	List of Parts for K240 Turbo-Generator		Appendix D
Pyle-National Co	Instructions for K240 Equipment	1/9/1940	Appendix E
NZ Railways	Drawing w16522 - Instructions For The Inspection And Overhaul Of Electric Lighting Equipment On Steam Locomotives	14/4/1951	Appendix F
NZ Railways	Steam Locomotive Handbook of Instruction (Extract)		Appendix G

Other Information

NZ Railways	Code 23 - Electric Headlights, Generators, and Equipment on Steam Locomotives	1/4/1947	
http://www.fronz.org.nz/network/B35201_Electric_Headlights_Generators_&_Equipment.pdf			

Notes

1. The contents of this manual have been digitised from photocopies of the original documents. The quality of the illustrations varies but is the best that could be achieved. The editor apologises for any errors that have occurred in the digitising process and requests that any found be notified to the FRONZ Secretary (secretary@fronz.org.nz).

2. Some of the documents included appear to be incomplete. If anyone has other information about Pyle-National Equipment pertaining to NZ practises please forward it to the FRONZ Secretary (secretary@fronz.org.nz) for inclusion in future versions.

3. The original documents are in a varity of formats. They have been converted to A4 size pages and page numbering and references (where applicable) have been adjusted.

THE PYLE-NATIONAL COMPANY

General Offices and Works
1334-13358 North Kostner Avenue
CHICAGO, ILLINOIS, U.S.A.

Export Department
INTERNATIONAL RAILWAY SUPPLY CO.
30 Church Street, New York City

Canadian Representatives
THE HOLDEN CO., LTD.
Montreal
Toronto - Winnipeg
Vancouver

OLIVER ELECTRICAL APPLIANCES

Manufactured by
THE PYLE -NATIONAL
COMPANY

Represent a recognized line of Electrical Appliances developed to meet the rigid demands of the railroads. They are of rugged design to withstand the severe service incidental to their use.

Cab Fittings

Car Fittings

Conduit Fittings

Locomotive Headlight and

Turbo-generator Fittings

Locomotive Fixtures

Classification Lamps

Marker Lamps

Back-Up Lamps

Hand Lanterns (electric)

Car Fixtures

Connectors

Junction Boxes

Fuse Boxes

Switches (all types)

Terminal Boxes

Plugs and Receptacles

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INTRODUCTORY

Pyle-National

Turbo-Generators

are of varied design and with capacity ratings as follows:

Type E-2	½ KW.	32 Volts to 110 Volts
Type E	1 ½ KW.	32 " " 110 "
Type E-S	1 ½ KW.	32 " " 110 "
Type E-3	1 KW.	32 " only
Type T	2 KW.	32 Volts to 220 "
Type M-2	2 ½ KW.	32 " " 220 "
Type M06	800 Watts	32 " " 110 "
Type M	3 KW.	32 " " 220 "
Type M	4 KW.	32 " " 220 "
Type M	5 KW.	32 " " 220 "
Type M	7 ½ KW.	32 " " 220 "
*Type M	7 ½ KW.	Train Lighting Unit
Type Q	15-20 KW.	" " "

*This unit is made for head end train lighting, giving 500 watts, 32 volts A. C. for cab load and 7,000 watts, 64 volts D. C. for train line.

For details of any machine enumerated above write for special booklet of type desired.

All Pyle National Turbo-Generators are self-contained units which do not require switchboards, rheostats or other regulating devices.

Their trustworthy performance has stood the test in a large and varied field of electric service.

Their very compact and accessible construction permits of their installation in close quarters.

The Standard machines operate on steam pressure from 125 pounds up. If it is desired to operate on steam pressure below 125 pounds, special low pressure nozzles will be furnished.

The economy of their operation is manifest in their low steam consumption and time saving maintenance.

The same degree of care and accuracy of inspection guards the material and workmanship in these equipments that has so fully justified the good reputation of Pyle-National products since 1897.

More than 100,000 Pyle-National turbines and generators have been sold for use in various fields, including:

Locomotive Headlights	Mining Operations
Train Lighting	Oil Wells; Well Drills
Train Control	Steam Wreckers.
Train Signals	Locomotive Cranes
Electric Locomotive Circuit-Testing	Steam Tractors; Steel Mills
Electro Pneumatic Braking	Dairy Machinery
Saw Mills	Harbor Craft; River Craft
Lumber and Logging Camps	Rock Drills; Quarries
Logging Locomotives	Steam Tugs
Sugar Industries	Passenger Craft
Steam Shovels	Flow Meters
Contractors; Dredges	Flood Lights
Drag Line Excavators	Electrolysis
Ditchers	Laboratories
Clam Shells	Battery Charging
Ore Handlers	Electro-Magnet
McMylers	Electric Welding
Public Works	Coal Handlers
Steam Strippers	Auxiliary Lighting
Cotton Gins	Discharging Explosives

Types “K-2” and “K”

Headlight Turbo-Generator

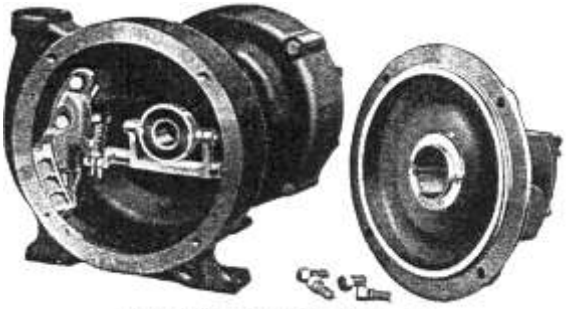
These two well known types of Pyle-National Turbo-Generators differ only in wheel and nozzle construction and in the turbine bearing arrangement. The Type “K-2” incorporates the latest developments of this type of turbo-generator. The Type “K” is considered in this pamphlet because of the great number applied to locomotives prior to the development of the Type “K-2." Detail illustrations of both types, together with separate inserts in the back of this pamphlet, serve to show the distinguishing features. In general, the Type “K-2” only will be referred to in these pages.

To convert Type “K” to Type “K-2” see instructions on page 14.

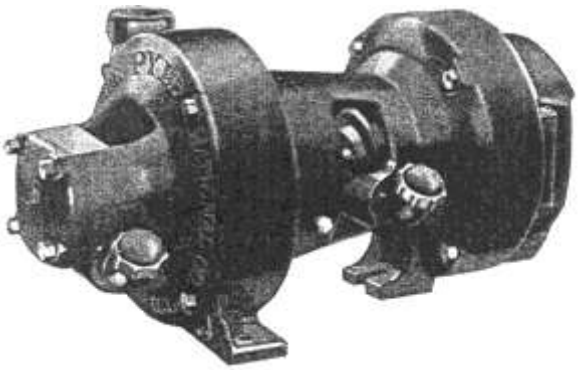
To the manufacture of Pyle-National Turbo-Generators, headlights and supplementary products there is given an individual attention unequalled in modern production. It is this advertent care which has justified the reputation for accuracy, interchangeability and finish that all Pyle-National products bear.

General Description The “K-2” equipment is suitable both for switching locomotives and locomotives in road service on which an incandescent headlight is desired. The capacity, 500 watts, is ample not only for the illumination of the headlight and cab, but for classification lamps, number indicator, deck and tender markers as well.

The compactness of the Type “K-2” Turbo-Generator, together with its capacity and efficiency, makes it most admirably suited for any electrical purpose within its rating.

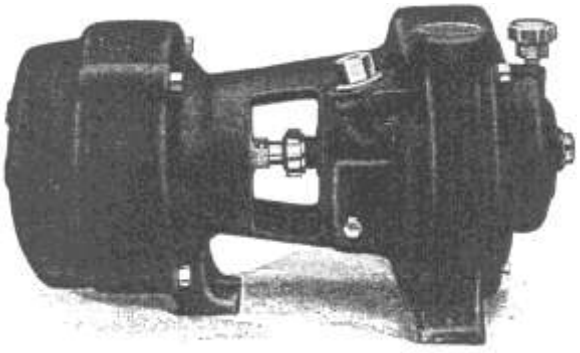


Type "K-2" Turbine (Interior)



"K-2" Turbo-Generator

	Type “K2”
Net weight	124 lbs.
Height	11 ¾ in.
Width	11 ⅝ in.
Length	22 in.
Capacity	500 watts
Voltage	32



"K" Turbo-Generator

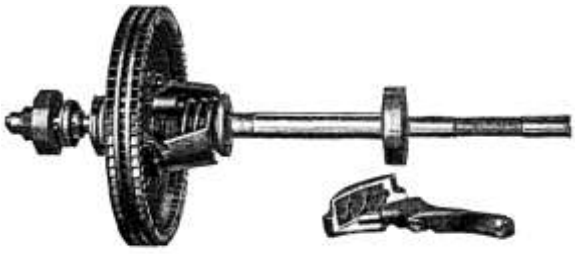
	Type "K"
Net weight	115 lbs.
Height	11 ¾ in.
Width	11 ⅝ in.
Length	20 ½ in.
Capacity	500 watts
Voltage	32

Refinements toward efficiency have resulted in a lower steam consumption than have ever before been obtained in a successful turbo-generator for locomotive headlight service. We shall be pleased to furnish steam curves and tables upon request.

Control The speed and voltage controls are combined in a positive regulating or governing mechanism of the centrifugal weight type, which also compensates for variation in boiler pressures between 125 and 250 pounds, saturated or superheated steam.

An important and economic feature of the regulating mechanism is that of conserving steam. In yards and stations, where possibly the cab lights only are necessary; or where the total requirement is below the maximum capacity of the turbo-generator, as with switching locomotives, the governor admits to the nozzle only sufficient steam to perform the actual work.

Steam is conveyed to the turbine by a ½-inch pipe. A strainer, easily accessible for cleaning effectively prevents scale or dirt from obstructing the mule. The exhaust steam is disposed of through a 1 ½-inch pipe.

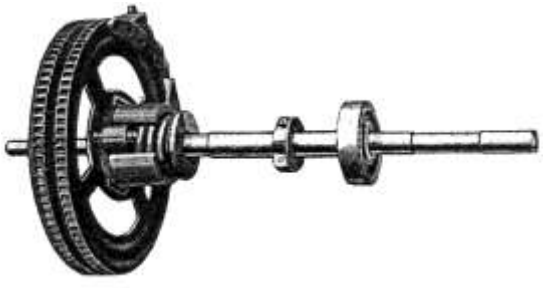


"K-2" Wheel, Shaft Bearings and Nozzle

Wheel, Shaft and Nozzle The "K-2" and "K" turbine wheel is forced on the shaft by hydraulic pressure. The wheel is steel. The buckets are of extruded material best suited to resist erosion by the steam jet, or corrosion; they are so arranged together with the nozzle and guide passages as to form a two velocity stage, radial flow turbine.

Shafts for Pyle-National turbo-generators are made from the finest steel obtainable for the purpose of high tensile strength, accurately pound to size and gauged to tolerances within .0002 of an inch, assuring perfect interchangeability.

A special treatment prevents rusting of that portion of the shaft within the turbine chamber and bronze and monel metal are employed for screws, etc.



"K" Wheel, Shaft Bearing and Nozzle

Generator Bearings The armature end *of* the shaft of both "K-2" and "K" turbo-generators together with the rotating parts, are supported by bail bearings mounted in hardened steel bushings which are easily removed from suitable dirt-proof chambers of generous lubrication capacity between the turbine and generator housings. They are supplied with lubricant through a large screw cover cup.

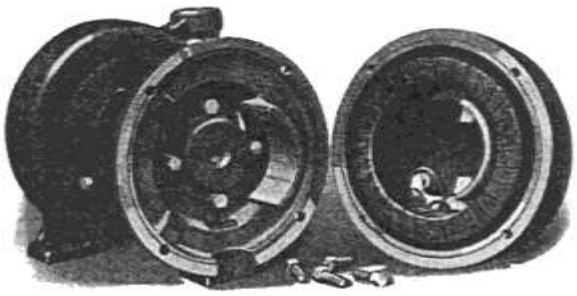
Turbine Bearing The turbine end of the "K-2" shaft is supported by a ball bearing mounted in a hardened steel bushing, easily removed from an oil chamber or cellar which is integral with the turbine cover, but insulated therefrom by an air space, assuring a low operating temperature. A dam is provided allowing the chamber cover to be removed without spilling lubricant. The turbine cover with all parts intact may be removed by unscrewing the four turbine cover cap screws only.

The turbine end of the "K" shaft is supported by a bronze sleeve bearing of special design. This bearing is amply supplied with lubricant by an oil ring feed from an oil cellar. This cellar is provided with an overflow which automatically drains off surplus condensation and maintains a constant oil level.

Because of this automatic overflow the oil level can be no higher than the shaft level, avoiding waste.

Both chambers on "K-2' and "K" turbo-generators are effectually' sealed against admission of dirt or moisture and escape of lubricant. A packing of ingenious design prevents the escape of steam from the turbine to the air space between the cover and the chamber. At the lowest point in the bottom of the oil chambers brass plugs provide means for draining and cleaning.

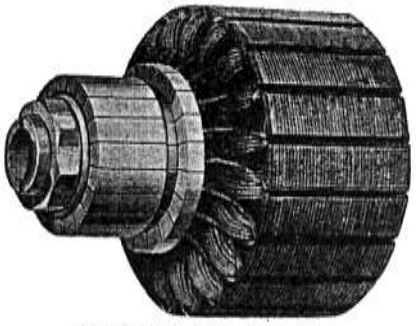
The oil chambers are replenished through large oil cups, conveniently located. The oil is fed directly to the bearings by immersion and oil rings.



Interior of "K-2" and "K" Generator

The generator is of the bi-polar, Lundell type.

Armature The windings are of large size (double cotton covered enameled wire). The compactness of the windings is given special attention in order to eliminate possible movement and friction within the individual coils. Formed mica flanges break the turns and superinsulate them from the edgings of the core.



"K-2" and "K" Armature

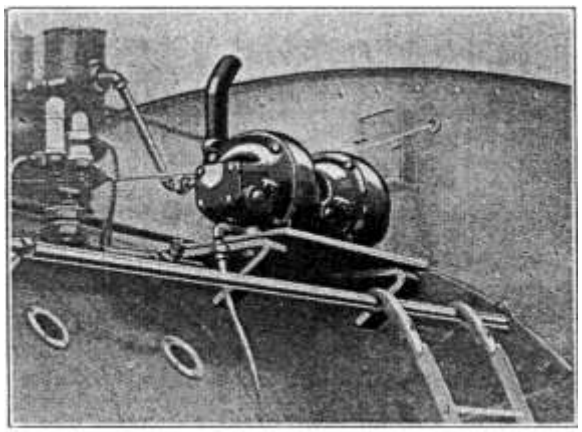
The armature and commutator form a unit. It is mounted on the shaft and securely locked in place by a single cap screw and a key washer, which engages a slot in the end of the shaft and a corresponding slot in the armature sleeve, facilitating removal and replacement.

Brush Holders The brush holders have a fixed position, and are securely mounted on the field frame.

Balancing of Rotating Parts Each rotating part of Pyle-National Turbo-Generators is accurately balanced, dynamically, for speeds greater than those attained in service.

Installation of "K-2" Equipment

The turbo-generator should be located on the left (Fireman's) side of the locomotive boiler with the turbine forward and generator towards the cab. See cut below.



"K-2" Turbo-Generator Mounting

If, however, it is desired to locate the turbo-generator on top of the boiler, it should be mounted forward of the whistle dome but as near as possible to the source of steam supply with generator end at left side of the locomotive. When mounted in this position care should be taken to see that the dynamo door and turbine cover are not fouled by the whistle rod or by piping.

It is sometimes necessary where the turbo-generator is mounted on top of the boiler to place it back of the whistle dome, in which case a protector plate should be provided to shield the turbo-generator against escaping steam.

Fasten supporting brackets which should be made of about ½-inch by 2-inch bar steel to the boiler with ¾-inch studs. The top surface of these should be level to prevent springing of machine when bolting down.

The steam should be taken from the fountain or dry pipe through a ½-inch pipe, with a ½-inch ***metal seat and disc globe valve,*** located conveniently for the engineer. A 1/2-inch tee should be inserted in the steam pipe near the turbo-generator ***through which engine oil should be introduced*** for the purpose of preventing the

accumulation of foreign matter on internal parts. A 1 ½-inch pipe should be inserted in the exhaust opening of turbine. To insure the best results this pipe should be short and free from angle obstructions.

The discharge end should be bent to insure the exhaust steam trailing back over the cab.

A ⅜-inch pipe nipple, 6 inches long, with union, should be connected at the drain hole in front, at bottom of turbine. This nipple should be bent slightly downward so that the union will not interfere when removing the turbine cover. Connect a drain pipe at the union and extend it through and to a point well below the running board. This pipe should have no valve or obstructions and should be as nearly vertical as possible.

Mount the headlight case on the platform or brackets regularly provided. In securing the case to the brackets it is essential that the case be accurately aligned, so that the beam of light from the reflector will be directed in a line parallel to the track. To accomplish good alignment of the case, washer-up the front or back as required. If the beam carries to one side swing the case around its vertical axis, drilling new bolt holes if necessary. ***Caution:*** When focusing the lamp in the reflector disregard entirely the alignment of the beam with the track. Focus only to obtain a concentrated, penetrating beam. The position of the case on the platform must be such that a well concentrated beam parallels the track. The purpose of the focusing device is to compensate for the difference in lamps and not to align the beam with the track.

No. 14, weather-proofed, slow-burning wire should be used for all lead wires on the locomotive. A good rubber covered wire may be used on the tender. Flexible drop cord with durable covering is best for cab drops. Suggestions as to supplementary material will be found on insert in back of book.

A metal conduit of suitable size should carry the wires from the generator to the headlight case and to the cab. The conduit should be laid parallel to the hand rail and clamped to its supports. A junction box provides the best means of joining the cab wiring to the outer system.

Wiring Diagrams Diagrams for the usual methods of wiring will be found in the inserts in back of pamphlet. For other combinations of wiring special blue prints will be furnished upon application.

Instructions Relative to Operation and Care of "K-2" and "K" Equipment

Lubrication Turbo-generators are shipped from the factory with only sufficient lubricant in the bearings to prevent rust. ***The "K-2" unit is not ready for service until the two cups have been filled with oil.*** Keep cups filled as long as machine is in service by adding oil as required.

When inspecting oil in cup if machine is running the oil level will be found to be below the level of the edge of oil cup.

Oil should not be added while machine is running, but only when it is standing still. If cup is filled while machine is running the oil cellars will be flooded and oil will run out of oil cup when cap is removed.

Oil for the "K" generator bearing is introduced through a hinged lid oil-cup on the side of main casting back of dynamo. ***This cup should never be filled more than half-full.*** If desirable to replace the older cup with the "K-2" Type, order Oil Cup, Complete, No. 419-C. Print for drilling and tapping the casting will be sent on request. The "K" turbine bearing chamber should receive about one-third (1/3) pint of oil before starting machine for the first time. Any more than this amount flows to waste by way of the overflow into the wheel chamber and to the ground through the turbine drain. Oil the turbine bearing liberally each trip. Keep oil-cups covered.

Clean oil of medium consistency should be used for lubricating both turbine and generator bearings. Engine oil, ***not car oil,*** is satisfactory. Condensation should be occasionally drained from the oil cellars by means of the plugged drain hole in bottom.

In order that the maintenance of turbo-generators may be as nearly uniform as possible, considering the wide range of their distribution, we have discontinued the practice of packing the bearing chambers with grease on new machines. Instead, the machines will leave the factory with only a small amount of lubricant worked into the bearings to prevent rust and with bearing oil rings (No. 1622 and No. 422-A) in place for service.

The choice of oil or grease, as a ball-bearing lubricant, is optional with the user. Oil gives the most general satisfaction and is always obtainable. (See foregoing instructions.) However, the proper grease, correctly applied and maintained, provides a lubrication which requires less attention than oil. It should not be necessary to replenish grease lubrication oftener than once a month. The grease should have good lubricating qualities, should contain no alkali, should not be acid and it should have a melting point of not less than 260° F.

If desirable to convert from oil to grease lubrication the bearings should be removed and washed thoroughly in kerosene (not gasoline) and, when dry, packed with grease. All oil residue must be cleaned from the cellars. Replace the bearings but omit the oil rings, and, by hand, force the grease into every corner of both cellars, filling the cups at the same time. It is unnecessary to fill the cellars to a point higher than the shaft. One and one eighth (1⅛) lbs. of grease is required to properly pack the two cellars. Do not use a grease gun nor compression grease cups in connection with grease lubrication.

Care of Turbine Interior A small quantity of engine oil or crude oil should be introduced into the turbine occasionally through the tee in the steam pipe and plug at top of turbine casing for the purpose of preventing and removing the deposit of foreign matter on the internal parts, or, in the absence of the tee, by removing the valve cap at top of turbine. This should also be done, when laying up the equipment, in order to prevent rust and corrosion.

Where the feed water contains lime deposits or is conducive to rapid corrosion, the interior of the turbine should be inspected occasionally.

Inspection is made by removing. the wheel and shaft intact, at the time the locomotive is held for periodic inspection and test.

Starting Turbo-Generator ***Turn on steam slowly.*** While it is impossible to injure the turbine by a sudden rush of steam, water, or any substance that could be carried into the turbine with the steam, it is advisable to allow sufficient time when turning on steam to permit the water from condensation to pass through the drain pipe. Should the turbine refuse to start, ***examine the strainer to see that the admission of steam is not prevented by an accumulation of pipe scale or other foreign substance.*** This may be done by removing valve

cap No. 613½ blowing out free scale after which any scale may be blown out by turning on steam before removing strainer and governor valve.

The throttle valve should be wide open when the turbo-generator is in operation. Cab lights should burn a bright yellow when full speed is attained.

Because of the low voltage (32 volts) there is no danger of electrical shock.

Brush Adjustment The brushes should fit perfectly on commutator; that is, the contour of the brush face should be the same as that of the commutator. The brushes can be fitted to the commutator by means of a strip of sandpaper which should be slightly wider than the brush. To accomplish this, raise brush and slip strip of sandpaper between brush and commutator, having sand side next to brush. Draw the sandpaper around commutator in direction of rotation. This will shape the brush 'perfectly. ***In no case use emery cloth or emery paper.***

Brush springs No. 142 should not bear against the brushes with excessive tension, as this creates undue friction between the brushes and the commutator, causing them to heat and wear rapidly. The brush spring tension should be just sufficient to prevent undue sparking. The pigtail of top brush should be connected to screw No. 112 and pigtail of lower brush to screw No. 111 situated on brush holders.

The proper spring tension for "K-2" and "K" brushes is 1¼ pounds, measured at the tips of the springs in the position at which they rest on the brush. To make an accurate adjustment use small spring scales.

To change spring tension release screw 144 until the brush spring adjuster 143 can be pulled out sufficiently far to turn either way.

If more than the proper tension is required to stop sparking at the commutator:

The brush may be poorly surfaced;
The brush may be too short;
The brush may be of poor composition;
The commutator surface may be rough;
The commutator may not be running true;
The mica between the commutator bars may need dressing down.

Commutator For ideal results the commutator surface must be maintained smooth and true. Should the commutator surface become rough, it should be smoothed by means of a strip of No. 0 sandpaper held in contact with the commutator while turbine is running. Hold sandpaper by its ends and do not press against it with the fingers, as this will increase the size of any spots that may be on the commutator. The mica insulation between the commutator bars should be maintained $^{1}/_{64}$ inch below the surface of the commutator. To reduce the mica insulation use a small three-cornered file.

Should the commutator become out of true, it should be removed, a mandrel fitted, and the commutator turned true in a lathe. Use a sharp-pointed tool for this operation and a very fine feed. Do not file. Finish its surface with fine *sandpaper*. After turning, the burrs between the copper bars and also the mica should be removed with a three-cornered file as above. Do not allow cinders, dirt or grease to accumulate about the commutator or any part of the equipment.

Speed Regulation Each turbo-generator unit is tested under service load at the factory, at which time the governor spring and governor valve are adjusted for the proper speed. While the turbo-generator is designed to deliver 32 volts at approximately 3,600 revolutions per minute, slight variations are unavoidable and we therefore recommend that speed adjustments be governed by volt meter readings. Where speed adjustment is necessary the governor spring and valve should be adjusted so that the voltage at dynamo will register 32 volts, ***with a steam pressure of not less than 125 lbs***.

This is accomplished by first adjusting the valve (see valve adjustment); then second by adjusting the governor screws (No. 617, on the face of the turbine wheel) until proper voltage is obtained. When adjusting the governor screws care should be taken that each screw is turned an equal amount. Turning the screws to the right will increase the voltage and turning the screws to the left will decrease the voltage. However, ***the governor screws should not be adjusted*** until after the governor valve has been set and the speed or voltage readings taken.

Valve Adjustment As wear takes place in the operating parts, the speed of the unit and the voltage will increase (lights get brighter), which indicates that the governor valve needs adjustment. When properly adjusted, the top of the governor valve will be flush with the top of its cage (see cut below).

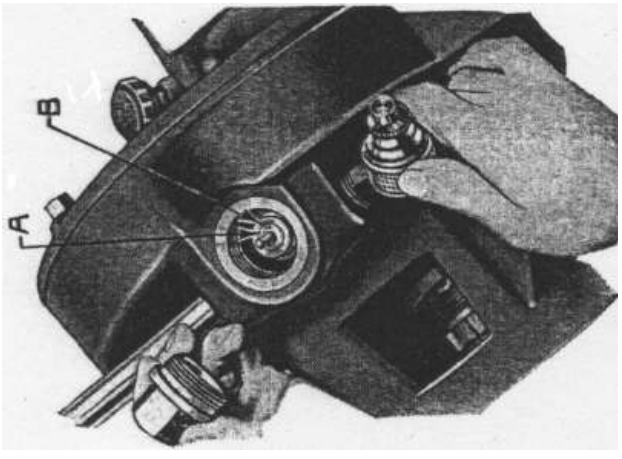
It is better to make valve adjustment at time of periodical inspection of equipment, once each 30 days, than to wait for the increase of speed to be indicated by the lamp brilliancy.

To determine whether valve is properly adjusted, remove valve cap and strainer. The position of the top of valve is then easily seen. (See illustration, below). Be sure, however, that the cage remains tight in its position and does not "ride" up on its spring, which would give the valve a false position and make it appear to need adjustment.

All valve adjustments should be made with turbine wheel and cover in place.

After removing the valve and cage from turbine (see below), adjust the nuts 615A and 618 until the top of the valve is just flush with the top of the cage ***when the valve and cage are held tightly in place in the casing***, with the strainer removed. (See illustration, below.) The nuts 615A and 618 should be securely locked after the proper adjustment has been made.

Note - On Governor Valves sent from the factory for repairs, the nuts 615A and 618 are not adjusted. Proper adjustment must be made before such valves are placed in service.



When properly adjusted. top of Governor Valve A will be flush with top of its cage B, when the cage is firmly seated in the turbine casing

When the adjustment of the nuts 615A and 618 have reached the wire key through end of valve stem, the anti-friction ring should be replaced (see directions, page 15); the nuts 615A and 618 should then be moved back to upper end of the threads on valve stem, after which readjust the valve as above.

A joint is made in the top of the strainer body No. 712, and while it is important that this joint seats, it should be ***tightened with the fingers only.***

Piston Governor Valve Spring Tension The Governor Valve Spring No. 616A should not have more tension than is necessary to force the valve to open position when the machine is at rest.

About one-half inch (½") compression of the spring between the nut No. 615A and the shoulder on the valve cage will be found sufficient.

Note - Bear in mind that the tension or adjustment of the Governor Valve Spring No. 616A has nothing whatever to do with Speed Regulation or Governor Valve Opening. The function of this spring is only that of adding sensitive action to the valve and forcing it to open position.

Valve and Cage Removal Remove valve cap No. 6131/2 and before removing valve or strainer, turn on steam, which will blow out all scale or foreign substance from the cavity surrounding the strainer.

If valve cage sticks and cannot be removed easily from turbine when hot, pour about a quart of cold water on top of valve cage and strainer. This will loosen the cage and allow it to be readily

removed by striking the outside of turbine casing a light blow with a hammer.

Valve and Cage Replacement Before replacing, be sure no dirt or scale remains in the recess into which the valve cage fits. Should the turbine casing be hot, first heat the valve and cage, in steam, to near the temperature of the casing. Sticking will result if the valve cage is not warmed before being put in a hot turbine. Screw the strainer on to the valve cage with the thumb and fingers only, and drop into place. Replace the valve cap and copper gasket, tighten with wrench.

To prevent sticking of the valve cage and assist in its removal from the turbine, swab the taper hole in the casing and also cover the valve cage steam joints with a coating of fine graphite, rub the graphite in the metal with a swab or by the hands. Exercise care that a thick accumulation of graphite is not present in either the taper hole or on the valve cage as a heavy coating is liable to cause steam to leak by the steam joints and prevent the best control of the turbine.

Flake graphite may be used; it is best, however, to employ fine powdered graphite as it is not so likely to cake and form heavy deposits on the surfaces, causing leakage.

Governor Unit The governor unit is composed of the two governor weights, the governor spring, the governor yoke and governor sleeve. They are attached to the inside face of the wheel with governor adjusting screws. The wheel is then balanced, after which one governor weight and one end of the governor yoke is marked with a small center punch. A corresponding center punch mark appears on the wheel, to guide the repairman should he find it necessary to remove and replace them.

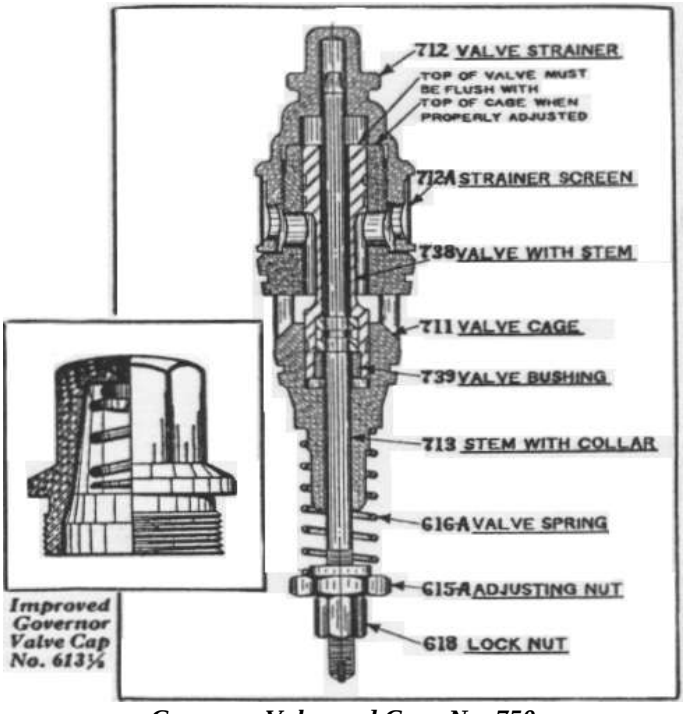
Should it be necessary to replace the governor unit, or any of its parts, the wheel ***with governor unit attached***, should be rebalanced.

Governor Spring On all complete turbo-generators, the governor spring is tested and set for the proper speed under service load, before the equipment leaves the factory. It should ***not be necessary*** to make further governor spring adjustment before the machine is placed in service.

On wheels and governor units shipped for ***repairs*** the governor spring is tested but ***not set***.

It is therefore necessary to make the proper governor spring adjustment, after applying a new wheel or governor unit, before placing the machine in service.

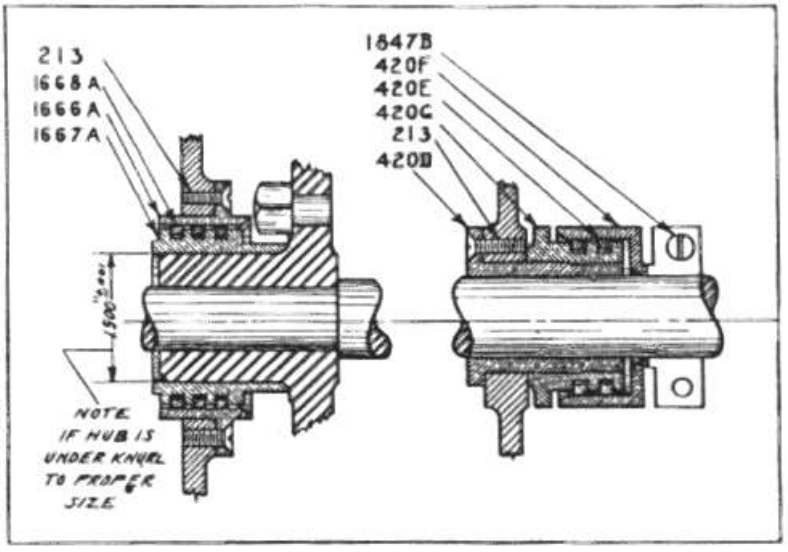
It is always advisable to check the governor valve adjustment when replacing a wheel or governor unit, as all compensation for anti-friction ring wear must be made by first adjusting the governor valve before making governor spring adjustments. (See speed regulation, page 10.)



Governor Valve and Cage No. 750

Improved Governor Valve Cap No. 613½ The improved valve cap as shown above will be furnished complete as No. 613½, comprising the cap No. 613B, valve retaining spring No. 734A, and spring retaining screw No. 734B attached as a unit.

This valve cap complete supersedes valve cap No. 613A and valve retaining spring No. 734 and will interchange therewith and also with all preceding Pyle-National valve caps.



Turbine Hub Packing
Complete No. 1671 for Type "K-2"

Turbine Case Packing
For Type "K-2" No. 420H

Packing Spring ring packings are employed, which prevent all leakage of steam from the turbine casing at the shaft and wheel hub. The Pyle-National spring ring packing requires no attention and can be applied without machining to turbo-generators on which soft packing is used by simply replacing the glands of the soft packing with those of the spring ring packing.

Converting "K" to "K-2" Frequently, users decide to convert their Type "K" turbo-generators to the more efficient Type "K-2," thereby reducing steam consumption and eliminating the turbine sleeve bearing. Such a change requires only:

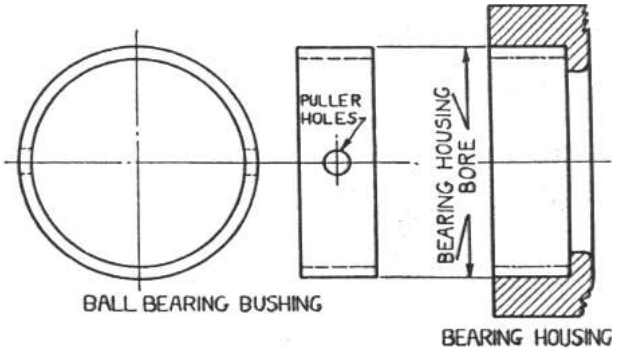
1 K-2 Turbine Wheel and Shaft No. 402-BN.
1 K-2 Nozzle and Guide Passage, No 460.
1 K-2 Turbine Cover with Outer Packing Sleeve, Ball Bearing and Sleeve, Complete, No. 404-N.
1 K-2 Turbine Case Packing, No. 420-H.
1 Modified K-2 Oil Cup, No. 419-C.
1 Blue Print, No. 11-A-902.

Converting Sleeve to Ball-Bearing A desirable change in the Type "K" machine may be effected by replacing the sleeve-bearing turbine cover with that of the ball-bearing design. A slight modification of the turbine wheel hub is also necessary to complete the change. Request blue-print No. 11-C-314 as a guide when changing from sleeve to ball bearing. Although not essential, we would recommend the application of the later style generator oil cup when making the change.

Material required to make the change:

1 K-2 Shaft, No. 424-A.
1 K-2 Turbine Cover with Outer Packing Sleeve, Ball Bearing and Sleeve, Complete, No. 404-N.
1 K-2 Turbine Case Packing, No. 420-H.
1 Blue-print, No. 11-C-314.
1 Modified K-2 Oil Cup, No. 419-C.
1 Blue-print, No. 11-A-902.
1 1667A Packing Ring Retainer with Packing Rings.

Ball Bearing Bushings



Type "K-2" Equipment	Turbine Cover Housing	Field Frame Housing
Ball Bearing, No	1605	405
Bushing No.....	1603D	449
*Housing Bore.....	2.701"	3.093"

*Tolerances + 0.0004"
—0.0000"

Bushings The ball bearing housings of Pyle-National turbo-generators are now bushed with standard hardened and ground chromium steel bushings and when worn are easily removed by means of puller holes provided and new bushings pressed in.

The table above gives you the part numbers for ordering new bushings, also information necessary for reboring old equipment to take standard bushings. However, we strongly recommend that you return your castings to us for boring and bushing, because of the correct jigs and tools at our disposal. You will then have a true housing into which above standard bushings may be pressed.

Dismantling and Assembling

Armature Removal and Replacement The ease with which the armature may be removed and replaced is worthy of comment, as it is not necessary to remove the brush holders. Merely lift the brushes from contact with commutator; remove field frame screws at rear of field frame; remove front field frame with coil and brush holders intact; remove retaining screw and washer at end of shaft, and withdraw armature.

Replace in reverse order, making sure that hole in armature and the shaft are clean and that drive washer lugs enter slot in end of shaft and armature.

Field Coil Removal and Replacement Remove field frame screws and front field frame. Disconnect wires from brush holders and remove field coils. Replace in reverse order, with the single connection at top and double connection at bottom. Connect single (or top) terminal wire to screw No. 112 on top brush holder; lower ***(large)*** terminal to ***insulated*** binding post on lower brush holder, and small shunt terminal to screw No. 111 on lower brush holder.

Brush Holder Removal Remove brushes, brush holder screws, insulating washers and bushings. Disconnect field coil terminals and remove brush holders.

Brush Holder Replacement Replace insulating bushings in brush holder screw holes. Replace insulating washers and brush holder screws. Replace brushes and brush springs. Care should be exercised that all insulating washers and bushings are in their proper place to insure holders being insulated from the field frame and that brushes are properly aligned on commutator.

Wheel and Shaft Removal Remove turbine cover. Remove armature lock screw and drive washer. Loosen packing gland screw 1847B then withdraw wheel and shaft. If found to be sticking, drive shaft out by means of a drift, seating on bottom of armature lock screw hole, or by means of a hardwood block against end of the shaft. Do not strike end of shaft. The wheel is not intended to be removed from the shaft except for wheel or shaft replacement.

Shaft Renewals Spare wheels are always sent assembled on the shaft unless otherwise specifically ordered. Spare shafts are ground 0.009" oversize on the wheel fit to insure security when pressed into wheels that have been removed from used shafts. Before placing in service, always swing the reassembled wheel and shaft between lathe-centers to check against the possibility of a bent shaft.

Wheel and Shaft Replacement Replace in reverse order, making sure the lugs on drive washer enter slots in end of shaft and armature sleeve at commutator end. Be sure lock washer is in place under armature lock screw head and that lock screw is pulled up just snug enough to hold armature fast to shaft.

Anti-Friction Ring and Holder Renewal Remove wheel and shaft. Remove screws 632 and take the governor arm from the turbine chamber, when the screws 630 can be removed to release the old ring. With sandpaper clean the surface of the new ring and fit into governor arm so as to permit of free movement on the screws. See that screws are securely tightened. On replacing the governor arm be sure that the screws 632 are tight and that the governor arm operates freely.

"K-2" Turbine Bearing Removal Remove turbine cover cap, remove oil ring; withdraw bearing sleeve. The ball bearings can then be removed from the sleeve by removing the bearing lock nut and forcing the bearing from the sleeve. Replace in reverse order.

"K" Turbine Bearing Removal Remove turbine cover, unscrew and remove turbine cover screw cap. Remove small bearing screw, force bearing out about one-half inch, lift oil ring out of slot in bearing; withdraw bearing. Oil ring may be taken out through the slot on the inside of the turbine cover after the bearing has been removed.

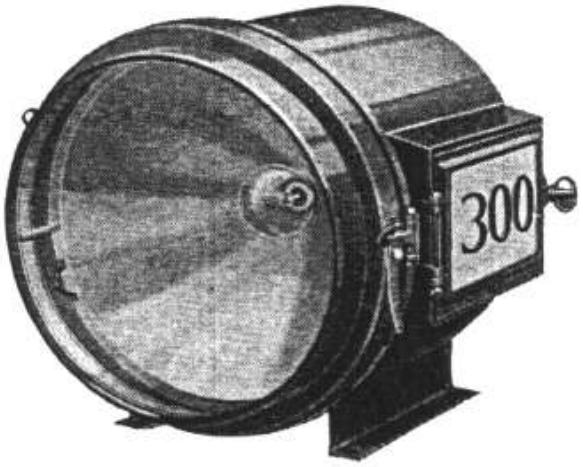
Insert oil ring through slot in turbine cover and see that the ring is central with the bearing opening; insert the bearing and force in about half way. Place oil ring in bearing slot and force bearing in until flange rests against the finished surface on turbine cover. Replace small retaining screw and turbine cover screw cap.

Generator Ball Bearing Removal. Remove front field frame (see directions [page 15] field coil removal). Remove armature (see directions page 15). Remove wheel and shaft (see directions page 15). Remove the cap screws situated in back of generator. Remove rear field frame and withdraw ball bearing.

Generator Ball Bearing Replacement Replace in reverse order, care being taken to tighten all screws and to see that the oil cellar is properly filled with ***good*** oil before starting.

HEADLIGHT CASES

On this and subsequent pages are illustrated a few designs selected from the very complete line of headlight cases manufactured by the Pyle-National Company. Prints and specifications covering any particular design will be furnished upon request.



Pyle-National Standard Incandescent Sheet Metal Headlight Case Print No. 20-C-300

The Pyle-National Standard Incandescent Case is made from rolled steel and malleable iron, reinforced by heavy steel bands. All seams and joints are electrically welded. Slotted holes in the base admit of adjustment for the purpose of training the light on the track after the case has been mounted on the locomotive. Holes are also provided in the back of case for the lead wires which attach to the terminals of automatic electric connectors.

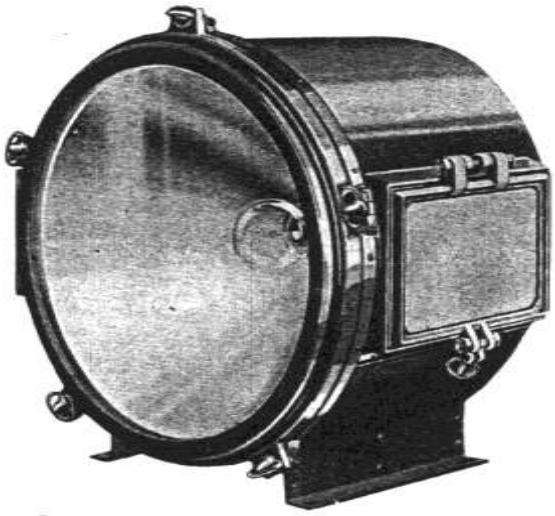
The lamp is mounted horizontally in the vertex of the reflector. A lock socket prevents the lamp working loose.

The incandescent lamp is focused by use of either the "micrometer" focusing device, No. 1450, or the No. 550. The No. 1450 is recommended as having the qualities for obtaining the finer focal adjustments. The No. 550 meets the usual service requirements and provides a rigid lamp support.

List of Parts used on 18-inch Standard Sheet Metal Headlight Case No. 20-C-300

No.	Name of Part
96-A	Insulation for 1846 and 1847.
111	Connecting screw.
112-A	Tinned iron washer.
115-F	Insulating bushing.
550	Lamp stand complete.
1086-C	Retaining screw for 9401.
1089	Retaining screw lock nut.
1090	Lock washer for 10-32 screw.
1091	Pressed paper washer ($^{3}/_{16}$" I.D.)
1436	Reflector retaining collar.
1450	Lamp stand complete.
1801-A	Front ring.
1802	Goggle hinge.
1803	Base, complete.
1804	Number glass door frame.
1805	Number glass door.
1810-L	Reflector base slide—left.
1810-R	Reflector base slide—right.
1811	Number light bracket.
1813	R. H. Reflector bracket.

No.	Name of Part
1813-A.	L. H. Reflector bracket.
1813-B	Reflector base bracket rivet.
1813-C	Reflector base bracket screw.
1816	Reflector base.
1817-N	Goggle with 1802 hinge and 1818 retaining ring and No. 1931-N goggle catch.
1818	Goggle glass retaining ring.
1824	Number glass spring.
1826	Reflector handle.
1827-C	Bracket for terminals.
1828	Reflector stop.
1840	Number glass (clear) 11¼" x 6⅜" x ⅛"
1841	Number glass (frosted) 11¼" x 6⅜" x ⅛"
1842-A	Goggle glass, 18" circle, ⅛" thick-oval.
1843-WR	Number frame latch, complete.
1844	18' x 9" spun copper reflector.
1845	Body, complete, including the following parts: Body, back, base, number glass door frame No. 1804, reflector base slide No. 1810-L, No. 1810-R, front ring No. 1801-A.
1846	Female contact.
1846-A	Female contact clips.
1846-B	Retaining screw for 1846.
1846½	Female contact, complete.
1847	Male contact.
1847-B	Retaining screw for 1847.
1847-C	Insulating washer.
1847-D	Retaining screw nut.
1847-E	Retaining screw nut lock washer.
1847½	Male contact, complete.
1928-N	Goggle latch, complete, 1929-N goggle latch cam handle, 1931-N goggle catch, 14017-J goggle latch pin, 1933-N fulcrum, 647 handle screw.
1929-N	Goggle Latch Cam Handle.
1931-N	Goggle Catch.
1932	Goggle latch pin.
1933-N	Fulcrum.
9401	Porcelain receptacle.
14017-H.	Goggle hinge pin
14017-A	Number frame pin.
14017-L	Latch pin.
20-C-300	Headlight, complete.



Pyle-National Hermetically Sealed Sheet Metal Headlight Care Print No. 20-C-300-N

This hermetically sealed case is designed to give a high, unvarying candle-power over a long period of time. This is accomplished by lacquering the silver surface of the reflector and by excluding moisture and gases from the case. Lamp replacement can be made without disturbing focal adjustment.

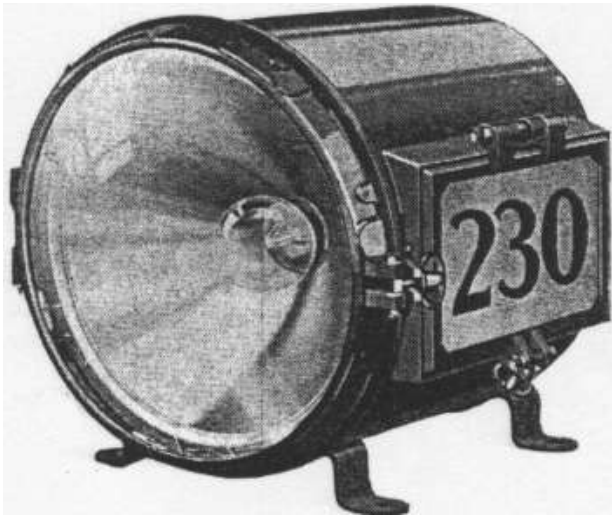
It has a standard 18" x 9" copper silver-plated reflector. The body is made of 16 gauge rust-resisting iron and covered with two coats of flexible baked enamel. A machine finished cast aluminum door and frame forms the front of the case.

This case can also be furnished with angle number frames; front and side number frames; or with side hand-hole.

List of Parts used on 18-inch Hermetically Sealed Sheet Metal Headlight Case No. 20-C-300-N

No.	Name of Part
97-B	Iron washer, tinned.
97-F	Insulating washer.
111-B	10-32 x 3/8" brass screw.
112-A	Iron washer tinned (/=' I.D.)
115-F	Insulating bushing.
1086-C	Number light retaining screw.
1089	Number light retaining screw nut.
1090	Lock washer for 10-32 screw.
1091	Pressed paper washer 3/16" I.D.).
1443-R	Front door latch.
1801-AT	Front ring.
1803	Body base.
1804-N	Side number frame.
1806	⅜” packing.
1807	⅛" packing.
1811.	Number light bracket.
1817-AT	Front door.
1818-AT	Front glass retaining ring.
1824	Number glass retaining spring.
1840	Number glass (clear) 6⅜" x 11¼" x ⅛"
1841	Number glass (frosted) 6⅜" x 11¼" x ⅛"
1842-A	18' diameter x ⅛" front glass-oval.
1843-R	Number door latch.
1844	18” x 9” spun copper reflector.
1845-AT	Body, including 1801-AT, 1804-N, 1803 and body and back.

No.	Name of Part
1850	Front glass gasket.
1850-F	Airtight focusing device.
2602-C.I.	Side number door.
9401	Number light receptacle.
14011-A	Terminal angle piece.
14011-N	Terminal screw nut.
14011-N3	Terminal block, complete.
14011-S	Terminal screw.
14017-G.	Number door retaining pin.
14017-L	Latch pin.
14017-M	Front door ¼" brass retaining pin.
14017-N	¼"-20 threaded brass nut.
14022	Side number door packing.
20-C-300-N	Headlight, complete.



Pyle-National Sheet Metal Headlight Case Print No. 20-C-230

No. 230—A New Headlight Case, built of best quality Sheet Steel throughout, and made complete with a

Pyle-National
14-inch "Nonglare" Glass Reflector

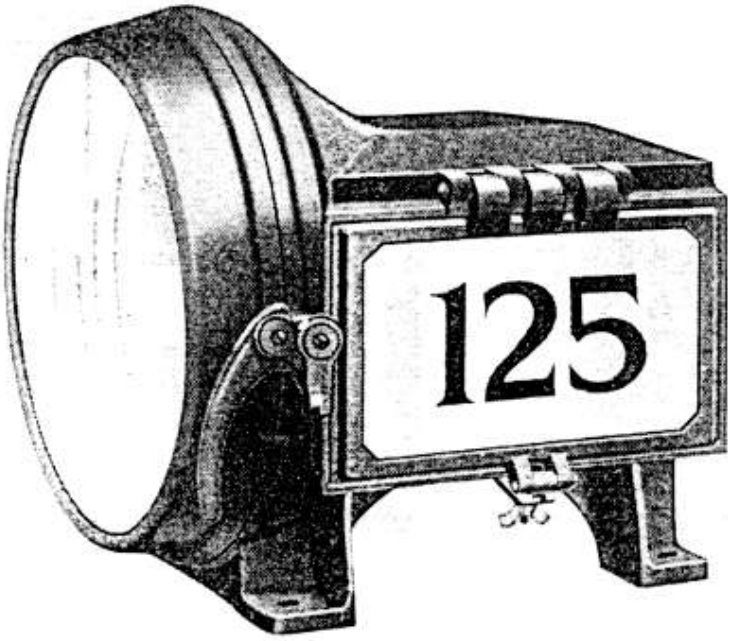
The seams are electrically welded. The joints maintain themselves smoke and moisture tight. Malleable frames and No. 250 focusing device. A cast aluminum mounting ring supports the "NONGLARE" GLASS REFLECTOR

The front door is of cast aluminum alloy.

This case can also be furnished with angle number frames; front and side number frames; or with side hand-hole.

No.	Name of Part
97	Insulating .washer.
97-B	Iron washer, tinned.
110	Insulating bushing.
200	Focusing device. complete.
1090	Lock washer.
1402-B	Body hinge.

No.	Name of Part
1403-CN	Steel foot.
1404-N	Number frame.
14117-MOC	Goggle, complete, comprising Nos. 2221, 1417-MO and 1467N
1417-110	Goggle only.
1421-A	Cord packing.
1124-U	Reflector shell.
1434	Lamp Socket.
1442-C	Goggle glass, 15⅛" x ⅛" circle-oval.
1443	Goggle latch, wing nut and bolt.
1443-B	Bolt only.
1443-W	Wing nut only.
1445	Body, complete, comprising Nos. 1445-A, 1415-B, 1403-CN, 1424-U, 1404-N, 1811. 1421-A, 14022-B, 1402-B, 1469.
1415-A	Body only.
1445-B	Body back.
1467-N	Goggle glass clip.
1468	Goggle glass gasket.
1469	Latch catch.
1811	Number light bracket.
1811-A	Number light bracket screw.
1811-B	Number light bracket screw nut.
1820-B	Door pin, brass.
1821-BA	Latch pin, bras.
1824	Number glass spring.
1840	Number glass, clear-6⅜" x 11¼" x ⅛".
1841	Number glass, frosted-6⅜" x 11¼" x ⅛".
1843-W	Number door latch.
1846-BR	Reflector retaining ring screw, bronze.
1961	14-24x⅝" brass screw.
2602-C.I.	Number door.
2619	Reflector retaining ring spring.
9401	Number light receptacle.
14003-A	Reflector retaining ring.
14011-A	Terminal angle piece.
14011-N	Terminal screw nut.
L4011-N3	Terminal, complete.
L4011-S	Terminal screw.
L4012	Reflector retaining ring packing.
14013	Reflector pad.
14014	14" NONGLARE glass reflector.
14022	Number glass packing.
14022-B	Number door packing.
20-C-230	Headlight, complete.



Print No. 20-C-125

"Pyle-National"
Cast Metal Headlight Cases
With "Nonglare" Glass Reflectors

combine features and refinements superior to headlight standards heretofore demanded as essential in a locomotive headlight case and are designed for practicability and economy.

The Standard 14-inch Cast Case is 16½ inches high. 14½ inches deep, 18 inches wide and weighs less than 45 pounds when cast in aluminum and 85 pounds in cast iron.

The body of the case is cast in one piece.

The front door and side number frame joints have a soft packing which makes them water sealed; smoke-tight and dust-proof.

A goggle door lock, ingenious in design and of durable construction securely locks the door when closed. One motion. Heavy hinges.

A weather-protected, accessible junction connects the case and locomotive conduit system.

This case also made with angle number frames; front and side number frames; or with side hand-hole.

If interested in 12-inch switching and transfer size, ask for descriptive information on cast case No. 20-C-6025.

List of Parts used on the 14-inch Standard Cast Metal Headlight Case No. 20-C-125

No.	Name of Part
97-B	Iron washer tinned, for ¼" screw.
97-F	Insulating washer for ¼" screw.
112-A	Iron washer tinned, for 10-32 screw.
115-F	Insulating bushing for 10-32 screw.
121	Lamp stand retaining screw (14-24x1¼").
550-A	Focusing device, complete.
1072	Brass washer (¼" I.D.).
1086-L	Number light receptacle retaining screw (10-32x1½").
1089	Nut for 10-32 screw.
1090	Lock washer for 10-32 screw.

No.	Name of Part
1091	Pressed paper washer ($^{3}/_{16}$" I.D.).
1421-A	Front door packing.
1438-A	Latch lug steel stud (door).
1438-B	Latch lug steel stud (body).
1467-N	Front glass retaining clip.
1479	Brass bushing (body hinge).
1479-A	Brass bushing (door hinge).
1824	Number door glass retaining spring.
1840	Number glass (clear) 11¼"x6⅛"x⅛".
1841	Number glass (frosted) 11¼"x6⅛"x⅛".
1843-R	$^{5}/_{16}$" eyelet latch (for number door).
1846-BR	Reflector retaining ring screw (14-24x1").
1847-D	Nut for 14-24 screw.
1847-E	Lock washer for 14-24 screw.
1933-A	Plain washer (½" I.D.).
1961	14-24x⅝" brass screw.
2602-C	Number door.
2617	Reflector shield.
2619	Reflector retaining ring spring.
9401	Number light receptacle.
14000-N	Headlight housing only.
14001-N	Front door only.
14003	Reflector retaining ring.
14004-N	Front door latch handle.
14006-EC	Latch catch eccentric brass bushing.
14006-H	Latch handle brass bushing.
14010	Front glass gasket.
14011-N	Nut for ¼"-20 thread screw.
14011-S	Terminal screw (¼"-20 thread x 1⅜"))
14012	Reflector retaining ring gasket.
14013	Reflector pad.
14014	14" non-glare glass reflector.
14017-N	¼"-20 thread brass nut.
14022	Number glass packing.
14022-B	Number door packing.
14026	Latch handle friction washer.
14033-B	$^{5}/^{16}$"-18 thread brass nut.
14042-C	Front door convex glass 14¾" diameter.
14017	Front door ¼" brass retaining pin.
14017-L	Numeral door latch ¼" brass retaining pin.
14020	Numeral door $^{5}/_{16}$" brass retaining pin.
20-C-125	Headlight, complete.

REPAIR PARTS

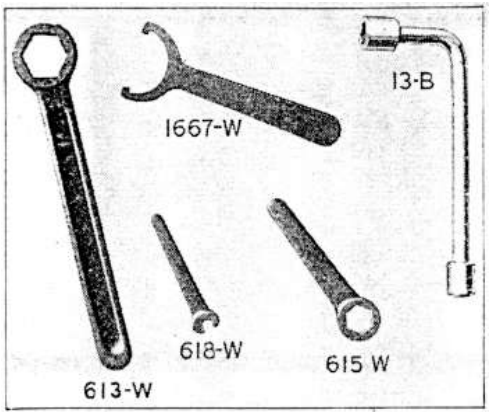
Good service cannot be expected from any equipment when inferior repair parts are used. A part poorly made has to be fitted before it can be used. Time is lost and the same results cannot be obtained as when properly constructed interchangeable repair parts are at hand.

All Pyle-National parts are made to gauge, are interchangeable, and are manufactured of the best materials obtainable for their purpose. Delays are avoided when ordering repair parts by specifying symbol numbers.

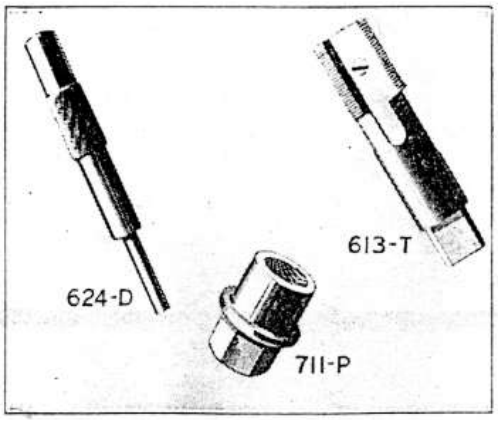
Every part manufactured by the Pyle-National Company bears this trade mark. If you do not find this trade mark on the parts furnished you, write us. This mark is for your protection.

Trade Mark Registered

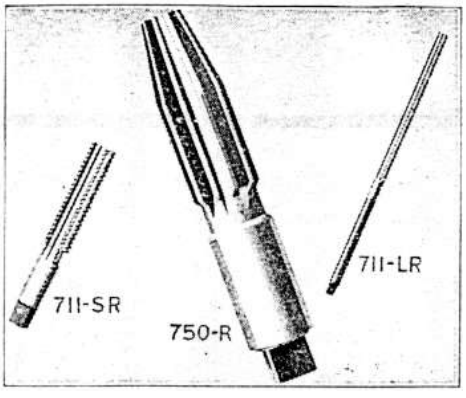
WRENCHES AND TOOLS



Part No.	Name of Parts
13-B	Socket Wrench for ⅜" and $^{7}/_{16}$" cap screws.
613-W	Box Wrench for No. 613½ valve cap.
615-W	Box Wrench for No. 615A valve adjusting nut.
618-W	Wrench for No. 618 governor valve lock nut.
1667-W	Spanner Wrench for No. 1667 turbine cover packing gland.



Part No.	Name of Parts
613-T	l½" Tap for valve cap threads in turbine casing.
624-D	Drift for driving out "K-2," "E-2," "E" and E-S" shafts.
711P	Puller for extracting No. 711 valve cage.

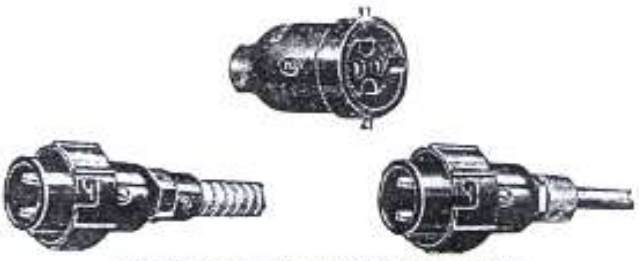


Part No.	Name of Parts
711-LR	Reamer for valve stem.
711-SR	Reamer for valve chamber.
750-R	Reamer for valve cage seat in turbine casing.

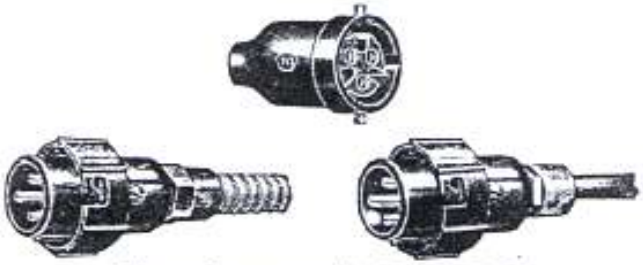
(OLIVER ELECTRIC & MFG. COMPANY)

Circuit Connectors

Plugs and Receptacles
For Use Between the Conduit System and the Headlight Case,
Classification Lamps and Marker Lamps
Headlight Case and Classification Lamps



Plugs for use with Type BRB
Two-wire Receptacle

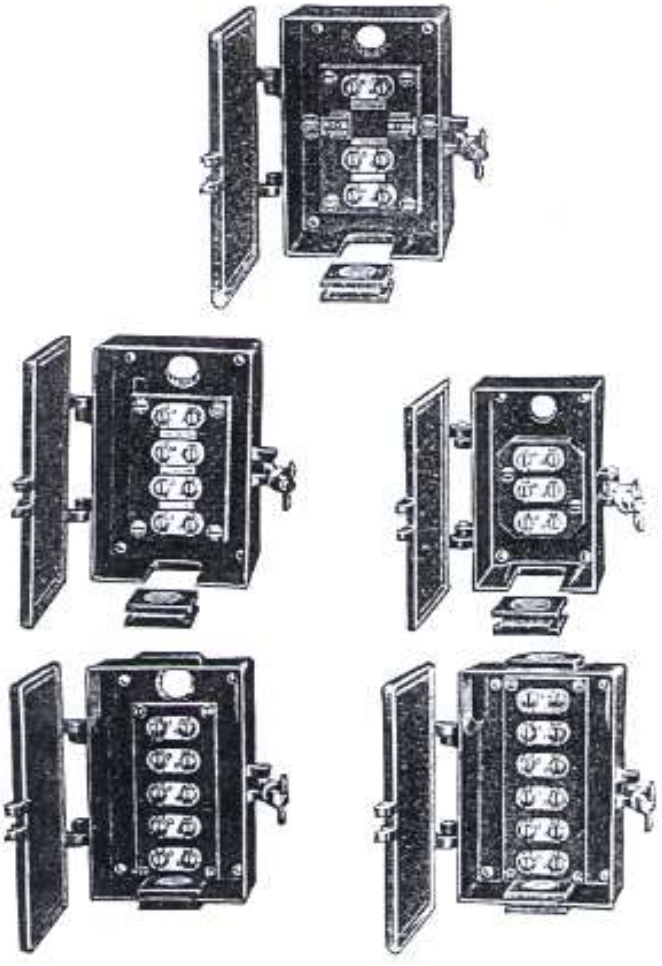


Plugs for use with Type BRB
Three-wire Receptacle

Locomotive Headlight Switches

(OLIVER ELECTRIC & MFG. COMPANY)

Locomotive Terminal Boxes



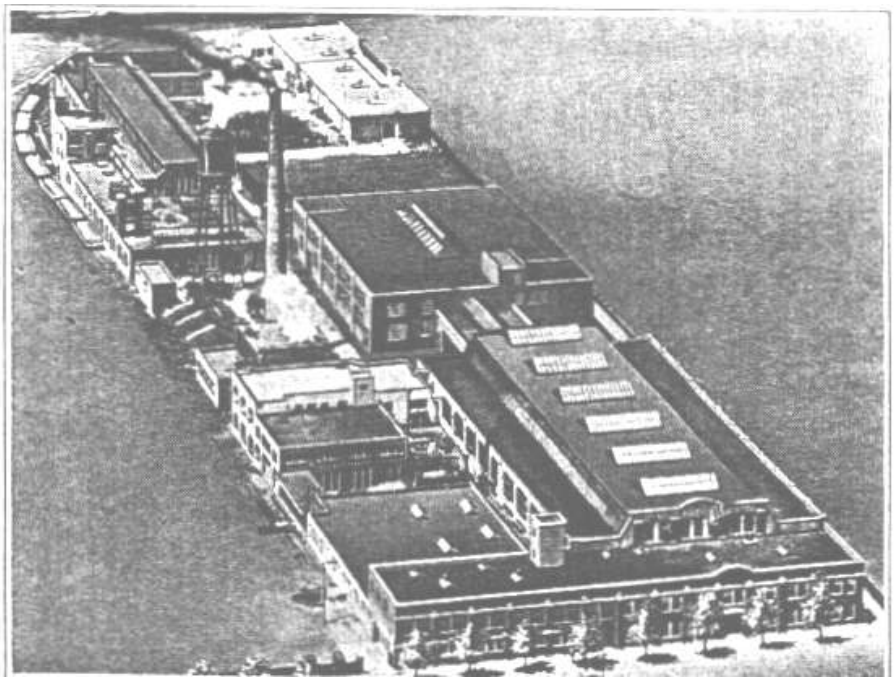
Weatherproof terminal boxes of rugged construction for use on the front of the locomotive cab so that the wiring and conduit can be readily connected or disconnected. These boxes eliminate the difficulty experienced by railroad maintenance men in quickly locating and repairing wiring troubles. When locomotives are shopped the cab can be removed without cutting the wiring, by disconnecting the conduit and wiring at this box.

Terminal block is made of moulded insulation and has heavy cast brass terminals with projecting ears. Terminals are furnished with large binding screws with washers to insure good electrical connection.

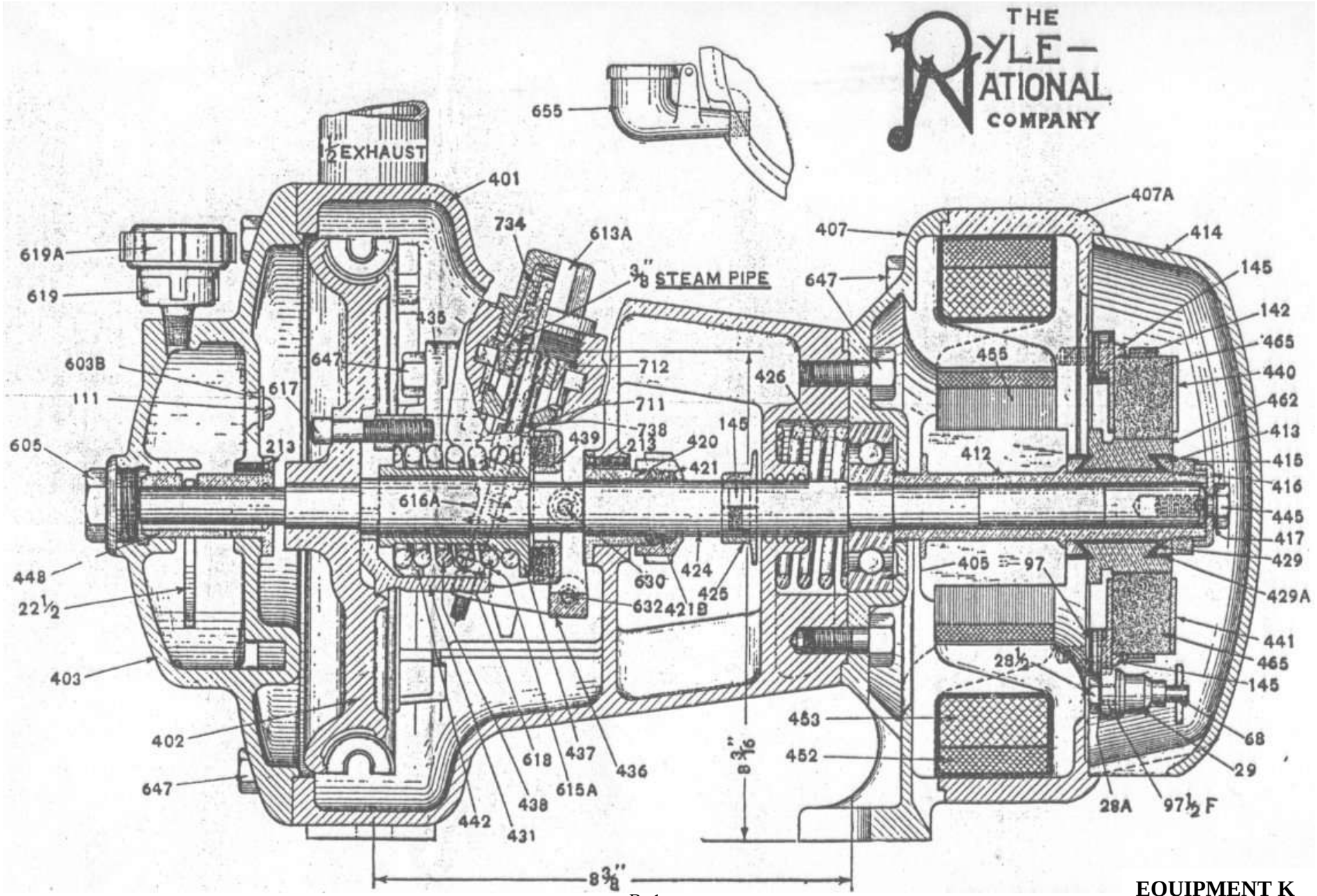
These two pages show only a few of our many types of Locomotive Fittings. Write for Catalogue.

List of U. S. Patents Under Which Pyle-National Headlight Equipments are Manufactured

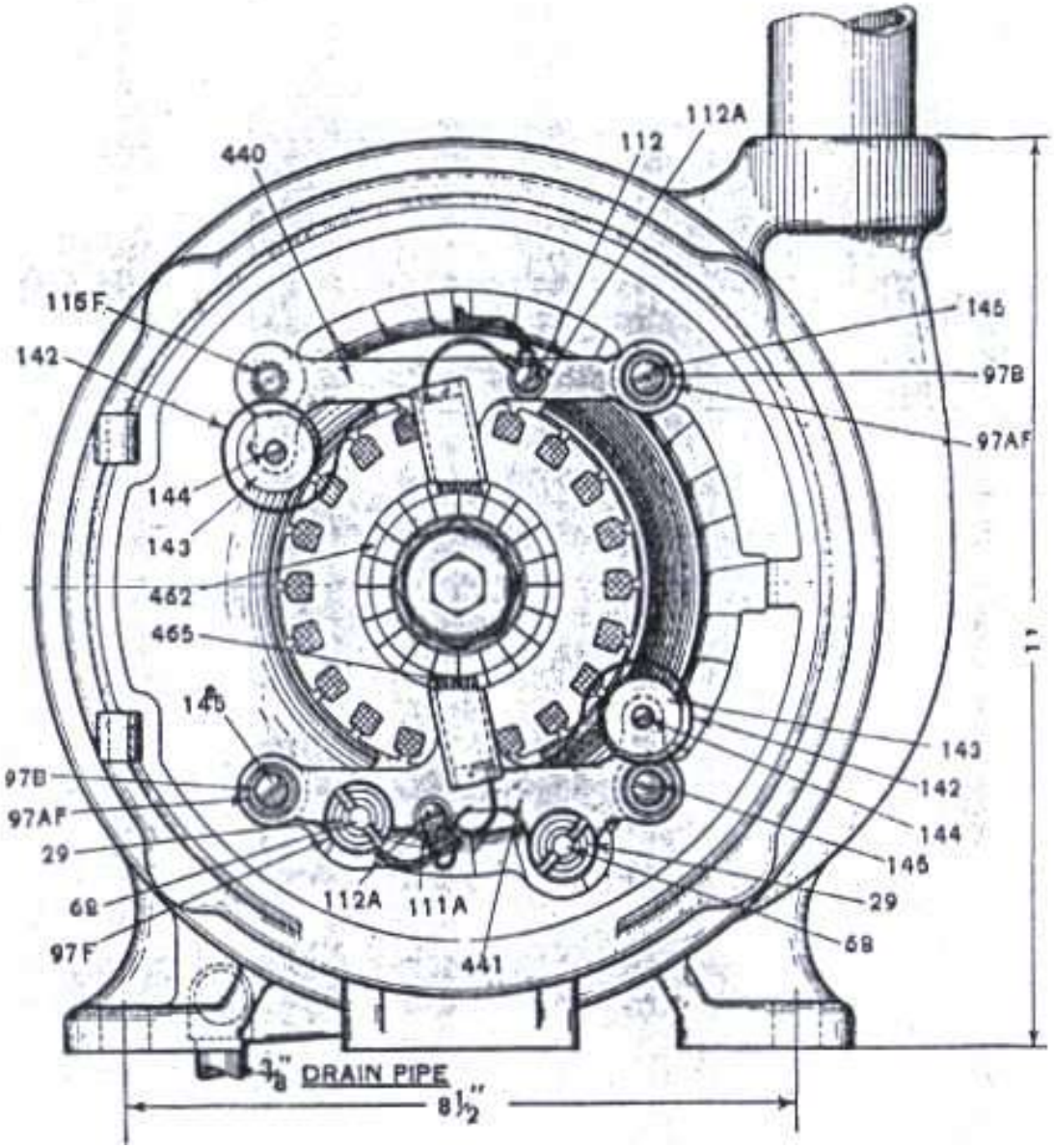
Date	Date
Aug. 8, 1905	Sept. 8, 1914
Oct. 9, 1906	Sept. 29, 1914
June 28, 1910	Dec. 22, 1914
Mar. 12, 1912	Feb. 9, 1915
Aug. 13, 1912	April 6, 1915
Aug. 13, 1912	April 27, 1915
Aug. 13, 1912	May 11, 1915
Aug. 13, 1912	May 11, 1915
Sept. 17, 1912	June 1, 1915
Dec. 24, 1912	July 6, 1915
Mar. 18, 1913	July 6, 1915
June 3, 1913	Aug. 31, 1915
Aug. 12, 1913	April 11, 1916
Feb. 10, 1914	May 16, 1916
May 26, 1914	May 30, 1916
May 26, 1914	Aug. 8, 1916
May 26, 1914	Dec. 9, 1916
May 26, 1914	Jan. 16, 1917
June 30,1914	Feb. 27, 1917
June 30, 1914	April 17, 1917
June 30, 1914	Dec. 3, 1918
Aug. 4, 1914	

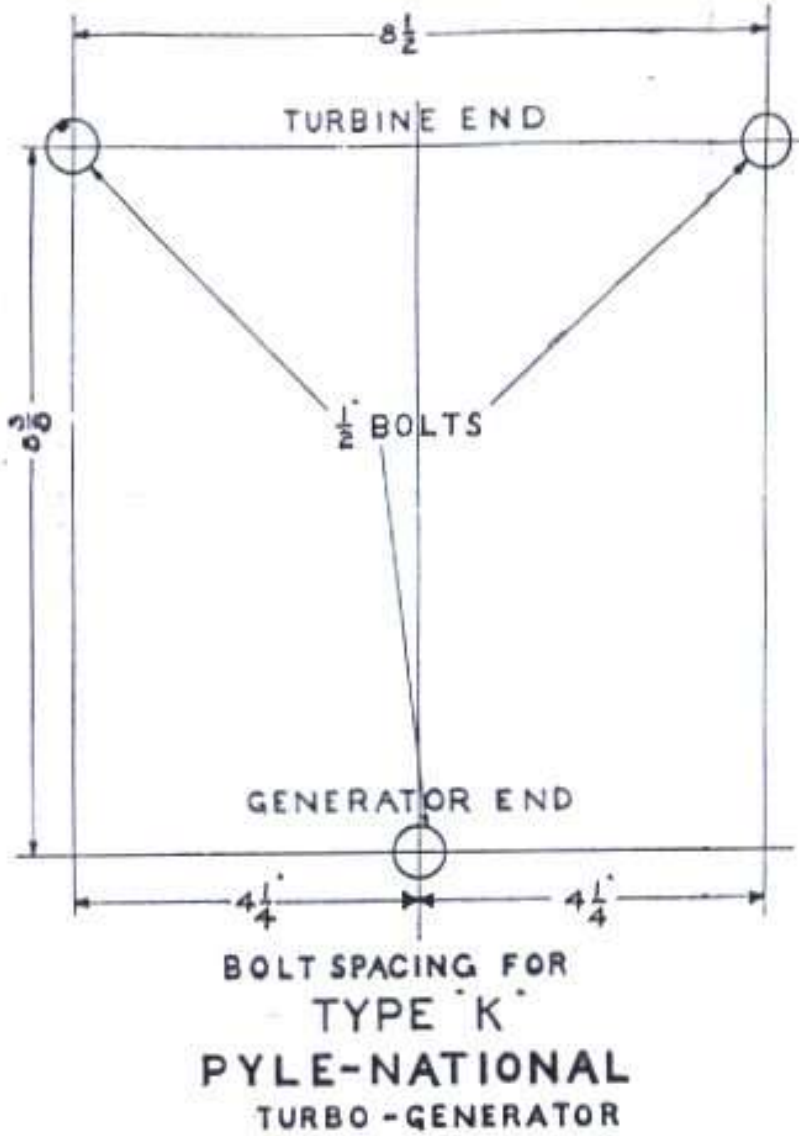


150,000 square feet of floor space devoted exclusively to the manufacture of Pyle-National electric headlight equipments. In addition to the Types "K-2" and "K" equipment, herein described, we also manufacture various other sizes adaptable for headlighting, train lighting and industrial purposes. Full information in regard to these will be furnished upon request.


THE RYLE—NATIONAL COMPANY
655
EXHAUST
401
734
613A
3/8" STEAM PIPE
407A
407
414
145
647
142
465
440
462
413
415
416
445
417
429
429A
441
465
145
68
29
28A
97½ F
619A
619
603B
111
605
448
22½
403
402
647
617
435
712
711
738
213
439
420
421
426
455
412
616A
424
425
630
632
421B
405
97
28½
453
452
8 3/16"
618
437
436
615A
438
442
431
8 3/8"

EQUIPMENT K


440
112
112A
116F
142
145
97B
97AF
144
143
462
465
145
143
142
144
145
97B
97AF
29
68
97F
112A
111A
441
29
68
11
7/8" DRAIN PIPE
8 1/2"


8 1/2
TURBINE END
8 3/10
1/2" BOLTS
GENERATOR END
4 1/4"
4 1/4"
BOLT SPACING FOR
TYPE "K"
PYLE-NATIONAL
TURBO-GENERATOR

LIST OF PARTS FOR TYPE "K" HEADLIGHT EQUIPMENT

No. of Part	Name of Part
12½A	Armature Spider Pin.
22½	Oil Ring.
28	Binding Post Nut.
28A	Binding Post Washer,
29	Binding Post, Small Hole.
29B	Binding Post, Small Hole, with Nut and Screw, Complete.
40	Reflector Clamp, Bottom.
40½	Reflector Clamp, Top.
41	Reflector Support
65	Binding Post Screw
81	Thumb Screw.
81A	Vertical Adjustment Thumb Screw.
97F	Insulating Washer, Large.
97AF	Insulating Washer, Small
97B	Brush Holder Iron Washer.
97½F	Insulating Bushing.
99	Vertical Adjusting Nut.
99A	Vertical Adjusting Lock Nut.
111	Oil Ring Slot Cover Screw.
111A	Shunt Field Connecting Screw.
112	Series Field Screw.
112A	Series Field Screw Washer.
115F	Brush Holder Insulating Bushing.
121	Reflector Clamp Screw.
132	Reflector Support, Complete.
134	Retaining Spring for No. 650a Governor Valve.
142	Brush Spring.
143	Brush Spring Adjuster.
144	Brush Spring Adjuster Screw
145	Brush Holder and Shaft Collar Screw.
145½	Brush Holder Screw, with Insulating Bushings and Washers.
209	Oil Cup Cover Chain Screw.
213	Screw for Nos. 420 and 448.

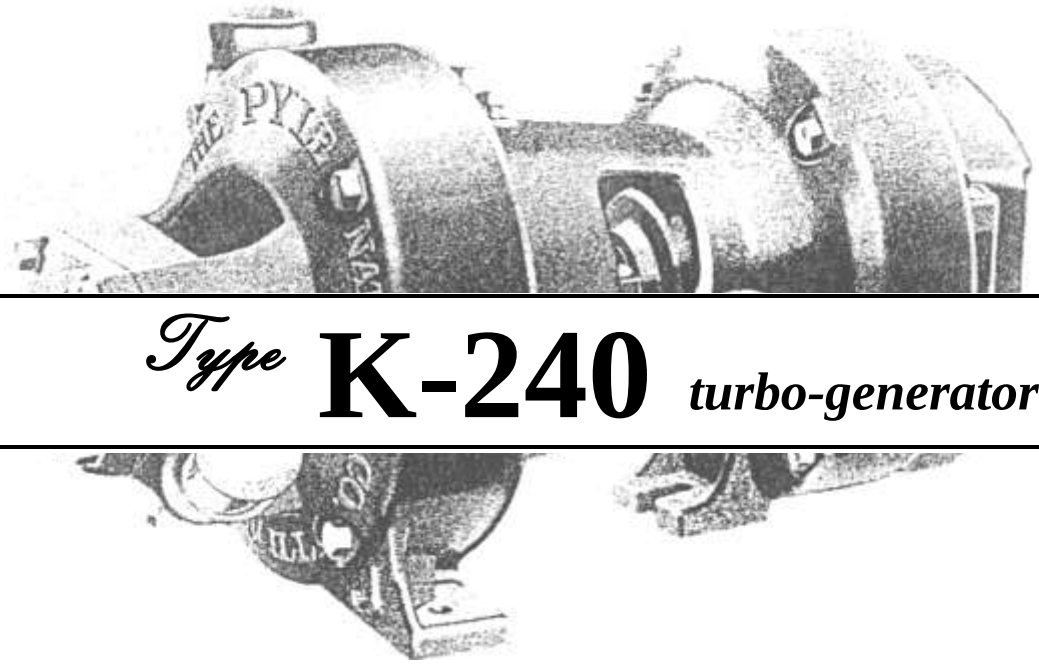
No. of Part	Name of Part
400	Turbine, Complete.
401	Turbine Casing, Complete.
402	Turbine Wheel, Complete.
403	Turbine Cover, Complete.
405	Ball Bearing.
407	Rear Field Frame.
407A	Front Field Frame.
412	Armature Spider.
413	Steel Commutator Ring.
414	Dynamo Door Complete.
415	Commutator Nut.
416	Armature Drive Washer.
417	Armature Lock Washer.
420	Turbine Case Bushing.
421	Packing Gland.
421B	Packing.
424	Shaft.
425	Shaft Collar.
426	Safety Spring
429	Mica Taper Ring
429A	Mica Band Ring.
429B	Commutator Bar.
429C	Mica Commutator Insulation.
430	Armature Lamination
430A	Slotted Paper Armature Disc.
431	Governor Weight.
435	Nozzle and Guide Passage.
435A	Nozzle Tube.
436	Governor Arm.
437	Governor Sleeve,
437½	Governor. Yoke, Sleeve and Spring, Complete.
438	Governor spring.
439	Anti-Friction Ring and Holder, Complete.
440	Top Brush Holder.

No. of Part	Name of Part
441	Bottom Brush Holder.
442	Governor Yoke.
445	Armature Lock Screw.
446	Top Brush Holder, Complete.
447	Bottom Brush Holder, Complete.
448	Bronze Bearing.
451	Dynamo Field Coil, Complete.
452	Shunt Field Coil.
452A	Insulating Ring for No. 452.
453	Series Field Coil.
453A	Insulating Ring for No. 453.
454	Dynamo and Armature, Complete.
455	Armature, Complete.
462	Commutator, Complete.
465	Commutator Brush.
470	Lamp Stand, Complete.
471	Lamp Stand Base.
472	Lamp Stand Clamp.
473	Ball Adjuster.
474	Lamp Stand Tube.
475	Lamp Socket.
476	Conductors.
477	Shoulder Thumb Screw, Large.
478	Socket Case.
479	Socket Case Base.
480	Lamp Socket (Porcelain).
481	Lamp Socket, Complete. Comprising Nos. 478, 479 and 480.
603B	Turbine Oil Slot Cover.
605	Turbine Cover Screw Cap.
611B	Valve Cage.
612C	Strainer.
613A	Valve Cap.
614B	Dynamo Door Pin.
614C	Dynamo Door Latch.
614D	Dynamo Door Latch Screw,
614E	Dynamo Door Latch Spring.

No. of Part	Name of Part
615A	Valve Adjusting Nut.
616A	Governor Valve Spring.
617	Governor Adjusting Screw.
618	Governor Valve Nut.
619	Oil Cup.
619A	Oil Cup Cover.
619B	Oil Cup Cover Retaining Ring.
630	Anti-Friction Ring Holder Screw.
632	Governor Arm Screw.
633A	Oil Cup. Complete.
638B	Governor Valve, Double Seat.
647	Turbine Screw.
647B	Look Washer for Turbine Generator Screws
650A	Balance Valve and Case, Complete.
665	Side Oil Cup, Complete.
655A	Side Oil Cup Cover.
655½	Side Oil Cup Body.
655B	Oil Cup Cover Rivet.
711	Piston Governor Valve Cage.
712	Piston Governor Valve Strainer.
712A	Piston Governor Valve Strainer Screen.
734	Piston Governor Valve Retaining Spring.
738	Piston Governor Valve with Stem.
750	Piston Governor Valve and Cage, Complete.
1430	Lamp Stand Extension
1430A	Lamp Stand Extension (Improved).
1430½	Lamp Stand Extension Complete.
1430½A	Lamp Stand Extension, Complete (Improved).
1431	Special Clamp Screw.
1432	Horizontal Adjusting Tube Spring.
1432A	Horizontal Adjusting Tube Spring (Improved).
1433	Spring for No. 1455.
1434	Lamp Socket
1435	Lock Washer for No. 1459.
1450	Micrometer Adjustable Lamp Stand, Complete.
1450½	Lamp Stand and Extension, Complete.

No. of Part	Name of Part
1451	Lamp Stand.
1452	Vertical Adjusting Frame.
1453	Side Adjusting Frame.
1454	Horizontal Adjusting Tube.
1455	Vertical Adjusting Frame Clip.
1456	Vertical Adjusting Frame Retaining Screw.
1457	Brass Adjusting Screw.
1458	Brass Lock Nut.
1459	Adjusting Tube Retaining Screw.
1460	Socket Retaining Screw.
1461	Rubber Bushing.
1619A	Oil Cup Cover Chain.
	Single Pole Single Throw Switch.
	Single Pole Double Throw Switch.
	Dimming Device for 250-watt Lamp.
	Dimming Device for 150-watt Lamp.
	Dimming Device for 100-watt Lamp.
	250 watt Type “C” Lamp
	150-watt Type “C” Lamp
	100-watt Type “C” Lamp
	60-watt Type "C" Lamp.
	25-watt special Masda Lamp.
	15-watt special Masda Lamp.
	10-watt special Masda Lamp.
	No. 31E Connector.
	No. 32E 2 Wire Connector.
	No. 33E 3 Wire Connector.
	No. 33U 2 Wire Connector.
	No. 34U 3 Wire Connector
	18-inch Oval Head1ight Glass.
	18-inch Flat Headlight Glass.
	14-inch Flat Headlight Glass.
	Side Glasses (Frosted and Plain).
	Socket Wrench.
	Speed Indicator.
	Receptacle for Indicating Number Lamp.

No. of Part	Name of Part
	Key Socket No. 50760 for Cab.
	Keyless Socket No. 50768 for Cab.



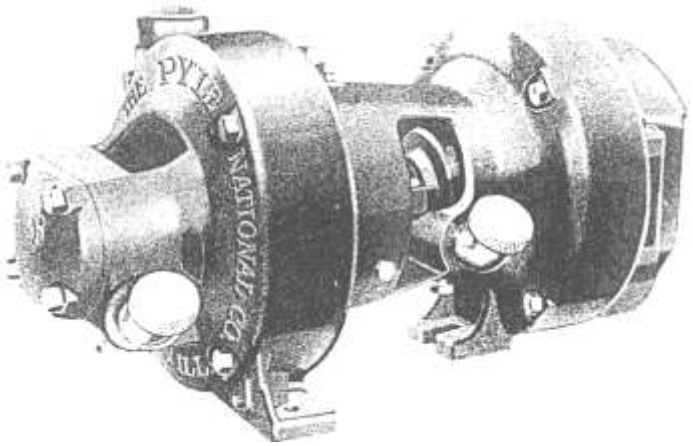
Type K-240 *turbo-generator*

compact, efficient, and
remarkably economical unit
for headlighting service

Bulletin
No 193

June
1937

The Pyle-National Company
Chicago, Illinois



The Type K-240 Turbo-generator has been specially designed to meet the rigorous demands of present day headlighting requirements

THE Type K-240 Turbo-generator, which is an improved Type K-2, represents a unit that is as modern as skill and science can produce. The general appearance has not been changed over that of the K-2 However, alterations in design of a number of important parts has made the K-240 a much more superior machine for performance and service. Generous use has been made of alloyed metals in order to obtain the necessary super-toughness to withstand the severe present-day operating requirements. The continuous research and experimental work conducted throughout our thirty-eight years as a leading builder of turbo-generators has led to many improvements that are now refinements in this unit.

GENERAL INFORMATION
Direct Current.
Capacity – 500 Watts.
Voltage – 32.
RPM – 3200 Full Load.
Poles – 2.
Brushes – 2.
Armature – Ring Wound.
Steam Pipe – ½ inch.
Exhaust – 1½ inches.
Height – 1 inches.
Length – $22^{5}/_{32}$ inches.
Width – 11⅝ inches.
Net Weight – 140 pounds.
Shipping Weight – 160 pounds.
Export Weight – 175 pounds.

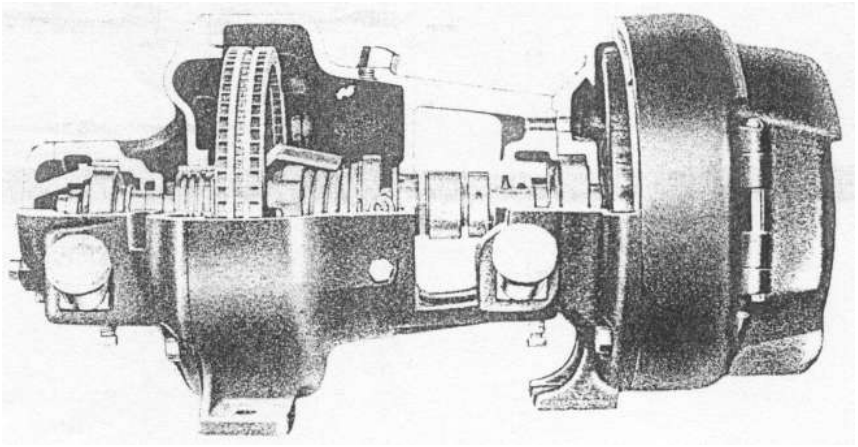
The turbine, which is the same as the K-2, is an impulse multiple velocity stage type. The steam on leaving the nozzle impinges on a series of buckets on the turbine wheel and is then discharged into a guide passage where it is re-directed through another of buckets before being released to the exhaust. By this method an exceptional operating economy is obtained as it increases the amount of useful energy obtained from the steam. The economy of operation that has made the K-2 turbine so successful for locomotive headlight service will be found further improved on the K-240.

The turbine governor valve and governor mechanism represent a highly perfected steam control that is accurate and sensitive to both wide fluctuation in load and steam pressures. For economy the governor valve permits only the amount of steam to enter the nozzle that is necessary for the actual load so that there is no waste under light loads.

Parts subject to excessive wear such as the valve cage, governor piston valve and turbine wheel blading are made of special nickel alloy. The metal because extreme hardness resists the severe cutting action of the steam and has the added advantage of being rust proof.

This construction is one of the many modern features that add much to the service life of the K-240.

A simple and effective bearing arrangement gives a smooth, steady operation and an unusually long service life. The ball bearings are of generous size and mounted in steel bushings of the same steel from which the bearings are made. This practice prevents wear in the ball bearing recesses and lessens maintenance attention. Special designed cellars with a large capacity are provided for the oil and through an improved method of lubrication a more efficient action is obtained together with a substantial savings in oil consumption.



Briefly, the method of lubrication consists in keeping the oil at a low working level to prevent flooding of the bearings and to limit the amount of oil carried to the bearings by the oil rings. The oil is permitted free passage through the bearings where baffles quickly return it to the oil cellars. The moderate amount of oil brought to the bearings and the quickness with which it is returned eliminates the necessity for shaft packing rings for sealing the bearing chambers and prevents oil saturation of outside parts such as the field coils. The oil rings in place of being of brass are now made of a Bakelite material of the same quality from which Bakelite gears are made. The rings being of this strong, hard material have their service life prolonged many times and because of the increased ability to carry oil they are more positive in their lubricating action.

The K-240 shaft is ruggedly constructed and to obtain additional strength and stiffness is turned from high carbon steel.

Much care is exercised in balancing each part that is mounted on the shaft to prevent an unbalanced condition on the ball bearings that would soon lead to bearing trouble.

The non-friction (Spring Ring) packing used to prevent steam leakage from the turbine casing at the shaft is a highly perfected seal that has proved its worth on thousands of Pyle-National turbogenerators. No attention is required and adjustments for wear are never necessary.

The generator on the K-240 unit has been greatly improved through the use of a forty bar commutator on the armature in place of the twenty bar commutator as used on the Type K-2. With the forty bar commutator the number of turns per coil on the armature is reduced by half with a consequent better current condition under the brush, which means longer commutator and brush life, better electrical performance and far less inspection and service attention.

Each part of the K-240 turbo-generator is substantially constructed and reflects a strength that will endure through many years of service. When considered as an equipment investment and counting the full cost of operating and maintenance, as well as the first cost of the unit, the K-240 offers the soundest purchase available today.

THE PYLE-NATIONAL COMPANY

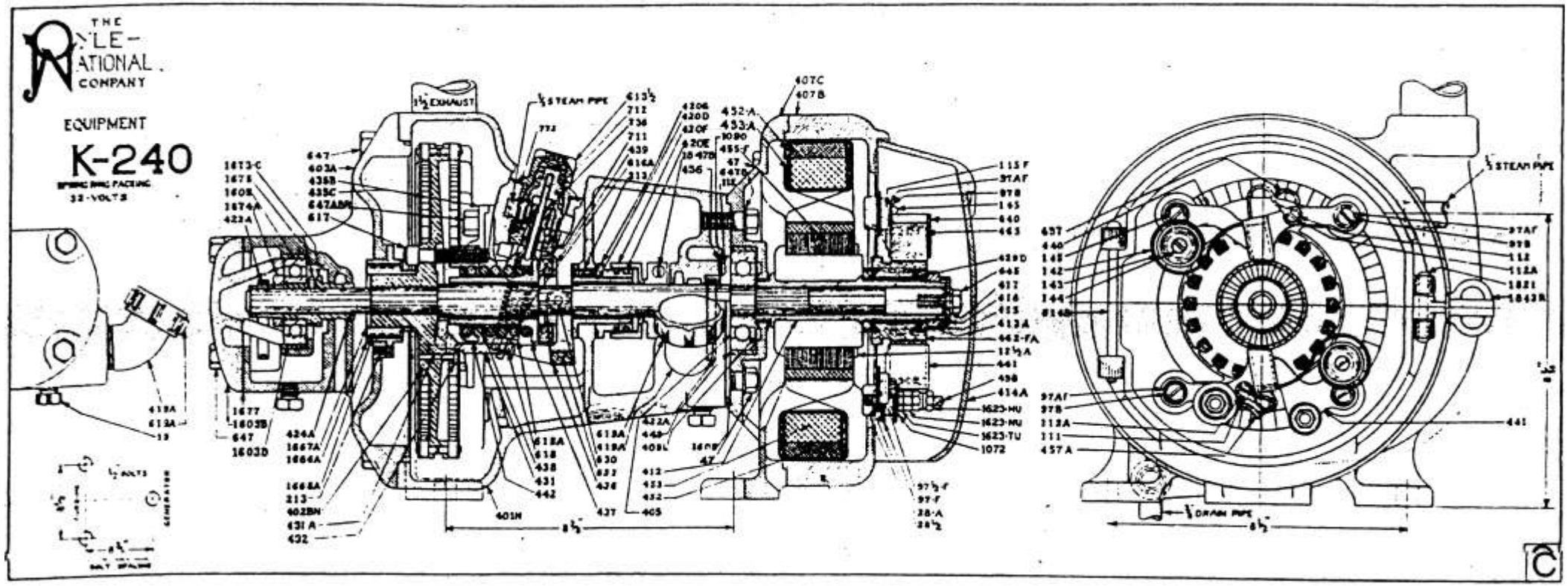
FOUNDED 1897

General Offices and Works: 1334-13358 North Kostner Avenue
CHICAGO, ILLINOIS, U.S.A.

BRANCH OFFICES

Grand Central Terminal ----------New York City
Boatman's Bank Building----------St. Louis, Missouri
Cadillac Square Building----------Detroit, Michigan
Builders Exchange Building ---------- St Paul, Minnesota
Hobart Building ---------- San Francisco, California

EXPORT DEPARTMENT : International Railway Supply Co., 30 Church Street, New York City
CANADIAN AGENTS : The Holden Company, Ltd., Montreal, Toronto, Winnipeg, Vancouver

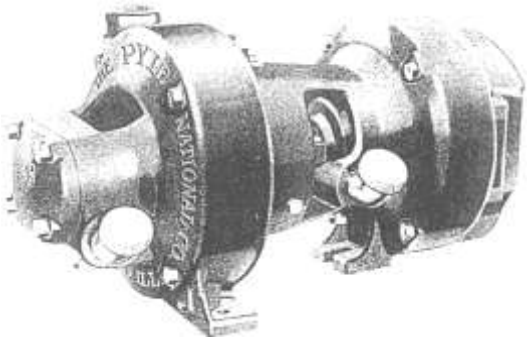

THE
KYLE-
NATIONAL
COMPANY
EQUIPMENT
K-240
32-VOLTS
1½ EXHAUST
½ STEAM PIPE
½ DRAIN PIPE
8½"

LIST OF "K240" TURBO-GENERATOR PARTS

No. of Part	Name of Part	No. of Part	Name of Part	No. of Part	Name of Part
12½A	Armature Spider Pin.	422A	Oil Ring.	613½	Valve Cap with Spring.
19	Oil Plug.	424A	Shaft.	614B	Generator Door Pin.
28½	Nut.	429D	Mica Taper Ring.	615A	Valve Adjusting Nut.
28A	Washer	*430	Armature Lamination.	616A	Governor Valve Spring.
47	Capscrew	*430AF	Armature Lamination.	617	Governor Adjusting Screw.
97AF	Insulating Washer, Small.	*430E	Armature Core Edge Insulation.	618	Governor Valve Lock Nut.
97B	Washer.	*430P	Armature Core Insulation.	619A	Oil Cup Cover.
97F	Insulating Washer, Large.	*430Q	Armature Slot Insulation.	630	Anti-Friction Ring Holder Screw.
97½F	Insulating Bushing.	431	Governor Weight.	632	Governor Arm Screw.
111	Round Head Screw.	431A	Governor Weight Guide Pin.	647	Cap Screw.
112	Round Head Screw.	432	Governor Weight Retaining Pin.	647ABR	Cap Screw.
112A	Iron Washer.	435B	Nozzle and Guide Passage Plate.	647B	Lock Washer.
115F	Brush Holder Insulating Bushing.	435C	Guide Passage.	711	Piston Governor Valve Cage.
*140A	Brush Spring Adjuster Pin.	436	Governor Arm.	712	Piston Governor Valve Strainer.
142	Brush Spring.	*436½	Governor Arm and Anti-Friction Ring,	*712A	Piston Governor Valve Strainer Screen.
143	Brush Spring Adjuster.		Complete.	*734A	Piston Governor Valve Cage Retaining Spring.
144	Brush Spring Adjuster Screw.	437	Governor Sleeve (with *437A Sleeve).	*734B	Piston Governor Valve Cage Retaining
145	Round Head Screw.	*437½	Governor Yoke, Sleeve and Spring,		Spring Screw.
*145½	Brush Holder Screw with Insulating		Complete.	738	Piston Governor Valve with Stem.
	Bushings and Washers.	438	Governor Spring.	*750	Piston Governor Valve and Cage, Complete.
*209	Oil Cup Cover Chain Screw.	439	Anti-Friction Ring and Holder, Complete.	773	Valve Cap Gasket.
213	Flat Head Brass Screw.	440	Top Brush Holder.	1072	Washer.
*401B	Turbine Casing (only).	441	Bottom Brush Holder.	1090	Lock Washer.
401N	Turbine Casing, Complete (with 420H	442	Governor Yoke.	1603B	Turbine Cover Cap.
	Spring Ring Packing).	445	Armature Lock Screw.	1603D	Ball Bearing Bushing (Turbine cover).
402BN	Turbine Wheel Shaft, Governor	*446	Top Brush Holder, Complete, with	1605	Turbine Ball Bearing.
	Weights, Yoke, Sleeve, Spring,		Brush Spring.	1609	Generator Gasket.
	Adjusting Screws and Packing Ring	*447A	R. S. A. Terminals Complete, Right and Left.	*1619A	Oil Cup Cover Chain.
	Retainer Complete.	*447AB	R. S. A. Terminal Right.	1623HU	Terminal Lock Nut.
403A	Turbine Cover with Bushing.	*447AC	R. S. A. Terminal Left.	1623NU	Terminal Nut (thick)
405	Generator Ball Bearing.	*447CP	Bottom Brush Holder, Complete, with	1623TU	Terminal Nut (thin)
405L	Generator Bearing Washer.		Brush Spring.	*1635B	Guide Passage Screw.
407B	Front Field Frame with latch.	449	Generator Ball Bearing. Bushing.	1666A	Outer Packing Sleeve.
407C	Rear Field Frame with Bushing.	*451	Generator Field Coil, Complete.	1667A	Packing Ring Retainer with Packing Rings.
412	Armature Spider.	452	Shunt Field Coil.	1668A	Packing Ring.
413A	Steel Taper Ring.	452A	Shunt Coil Insulating Ring.	*1671	Spring Ring Packing Complete (for Wheel Hub).
414A	Generator Door (only).	453	Series Field Coil.	1673C	Ball Bearing Sleeve.
415	Commutator Nut.	453A	Series Coil Insulating Ring.	*1673½ C	Ball Bearing and Sleeve Complete.
416	Armature Drive Washer Assembly.	455F	Armature, Complete.	1674A	Ball Bearing Retaining Nut.
417	Armature Lock Washer.	456	Oil Ring Support.	1675	Ball Bearing Drive Spring.
*419	Oil Cup, Complete.	457	Top Flexible Coil Lead.	1677	Turbine Cover Gasket.
419A	Oil Cup (only)	457A	Bottom Flexible Coil Lead.	1821	Generator Door Latch Pin.
420D	Turbine Case Bushing.	*460	Nozzle and Guide Passage, Complete.	1843R	Generator Door Latch.
420E	Packing Ring.	462FA	Commutator, Complete.	1847B	Round Head Steel Screw.
420F	Packing Gland with Screws.	*462F	32 Volt Commutator Bars with Insulation.	*14033L	Lock Washer
420G	Packing Ring Retainer with Packing Rings.	465	Generator Brush.		
*420H	Spring Ring Packing, Complete (Generator End).	498	Binding Post Stud.		

NOTE – Parts marked thus (*) are not shown in accompanying cut.

INSTRUCTIONS RELATIVE TO OPERATION AND CARE OF K-240 EQUIPMENT



"K240" Turbo-Generator

GENERAL DATA AND SPECIFCATIONS

Direct Current.
Capacity – 500 Watts.
Voltage – 24, 32.
RPM – 3400 Full Load.
Poles – 2.
Brushes – 2.
Armature – Ring Wound.
Bearings – No. 1605, Turbine End.
No 405, Generator End.
Height – $1^{11}/_{16}$ inches.
Length – $22^{5}/_{32}$ inches.
Net Weight – 140 pounds.
Shipping Weight – 160 pounds.
Export Weight – 175 pounds.

Lubrication Turbo-generators are shipped from the factory with only sufficient lubricant in the bearings to prevent rust. The K-240 unit is not ready for service until the two oil chambers have been filled to the top level of the cups with oil. As the oil cups are a measure for the proper oil level when machine is at rest, oil should be added at this time only.

Clean oil of medium consistency should be used for lubricating both turbine and generator bearings. A good grade of gas engine oil is most satisfactory.

Care of Turbine Interior A small quantity of engine oil, or crude oil, should be introduced into the turbine occasionally, through a tee provided in the steampipe, for the purpose of preventing and removing any deposit of foreign matter that may have collected on the internal parts, or, in the absence of the tee, by removing the valve cap at top of turbine cover. This should also be done when laying up the equipment, to prevent rust and corrosion.

Where the feed water contains lime deposits or is conducive to rapid corrosion, the interior of the turbine should be inspected occasionally.

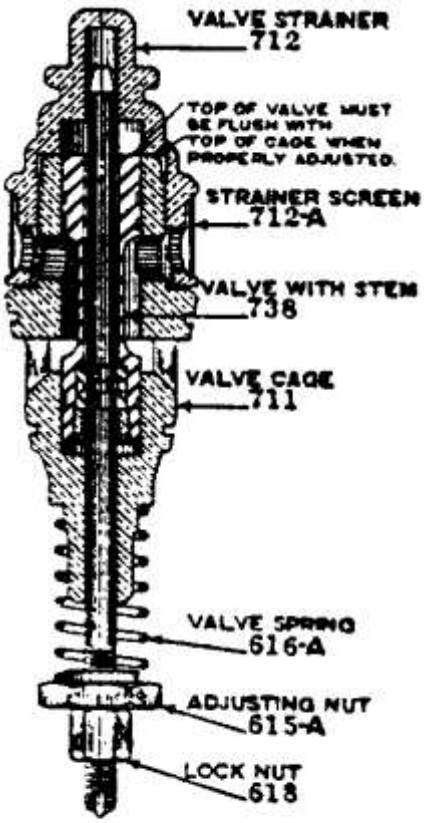
Inspection is made by removing the turbine cover at the time the locomotive is held for its periodic inspection and test.

Starting Turbo-Generator **Turn on steam slowly**. While it is impossible to injure the turbine by a sudden rush of steam, water, or any substance that could be carried into the turbine with the steam, it is advisable to allow sufficient time when turning on steam to permit the water from condensation to pass through the drain pipe, which should be free of all obstructions and not reduced in size and open at all times. Should the turbine refuse to start, examine the strainer to see that the admission of steam is not prevented by an accumulation of pipe scale or other foreign substance. This may be done by removing valve cap, No. 613 ½, and blowing out scale by turning on steam before removing strainer and governor valve.

The throttle valve should be wide open when the turbo-generator is in operation.

Speed Regulation Each turbo-generator unit is tested under service load at the factory, at which time the governor spring and governor valve are adjusted so that speed of turbine will be sufficient for generator to deliver its full voltage rating shown on name-plate and when speed adjustment is again necessary it should be governed by volt-meter readings.

Speed Adjustment This is accomplished by first adjusting the valve (see valve adjustment); then second by adjusting the governor screws, No. 617 (access to which is readily gained by removing turbine cover), until proper voltage is obtained. When adjusting the governor screws, care should be taken that each screw is turned an equal amount. Turning the screws to the right will increase the voltage and turning the screws to the left will decrease the voltage. However, the governor screws should not be adjusted until after the governor valve has been set and voltage readings taken.



Governor Valve and Cage No. 730

Valve Adjustment As wear takes place in the operating parts, the speed of the unit and the voltage will increase slightly, which indicates that the governor valve needs adjustment. When properly adjusted the top of the governor valve will be flush with the top of its cage.

It is better to make valve adjustment at time of periodical inspection of equipment, once each 30 or 60 days, than to wait for the increase of speed to be indicated by the lamp brilliancy.

To determine whether valve is properly adjusted. remove valve cap and valve strainer. The position of the top of valve is then easily seen. (See cut.) Be sure, however, that the cage remains tight in its position and does not "ride" upon its spring, which would give the value a false position and make it appear to need adjust-ment.

All valve adjustments should be made with turbine wheel and cover in place.

After removing the valve and cage from turbine (see valve and cage removal) adjust the nuts 615a and 618 until the top of the valve is just flush with the top of the cage when the valve and cage are in place in the casing, with the strainer removed. The nuts 615a and 618 should be securely locked after the proper adjustment has been made.

Valve and Cage Removal Remove valve cap No. 613½ and before removing valve or strainer, turn on steam, which will blow out all scale or foreign substance from the cavity surrounding the strainer.

If valve cage sticks and cannot be removed easily from turbine when hot, pour about a quart of cold water on top of valve cage and strainer. This will loosen the cage and allow it to be readily removed by striking the outside of turbine casing a light blow with a hammer.

Valve and Cage Replacement Before replacing, be sure no dirt or scale remains in the recess into which the valve cage fits. Should the turbine casing be hot, first heat the valve and cage, in steam, to near the temperature of the casing. Sticking will result if the valve cage is not warmed before being put in a hot turbine. Screw the strainer on the valve cage with the thumb and finger only, and drop into place. Replace the valve cap and copper gasket, tighten with wrench.

To prevent sticking of the valve cage and assist in its removal from the turbine; swab the taper hole in the casing and also cover the valve cage steam joints with a coating of fine graphite, rub the graphite in the metal with a swab or with the hands. Exercise care that a thick accumulation of graphite is not present in either the taper hole or on the valve cage as a heavy coating is liable to cause steam to leak by the steam joints and prevent the best control of the turbine.

Flake graphite may be used; it is best however, to employ fine powdered graphite as it is not so liable to cake and form heavy deposits on the surfaces, causing leakage.

Brush Adjustment The brushes should fit perfectly on commutator: that is, the contour of the brush face should be the same as that of the commutator. The brushes can be fitted to the commutator by means of a strip of sandpaper, which should be slightly wider than the brush. To accomplish this, raise brush and slip strip of sandpaper between brush and commutator, having sand side next to brush. Draw the sandpaper around the commutator in direction of rotation. In no case use emery cloth or emery paper.

Brush springs should not bear against the brushes with excessive tension, as this creates undue friction between the brushes and the commutator, causing them to heat and wear rapidly. The brush spring tension should be just sufficient to prevent undue sparking.

The proper spring tension is 1 to 1½ pounds, measured at the tips of the springs in the position at which they rest on the brush. To make an accurate adjustment use small spring scales.

To change spring tension release screw on brush spring adjuster, No. 143, until it can be pulled out far enough to turn either way.

Commutator For ideal results, the commutator surfaces must be maintained smooth and true. The mica insulation between the commutator bars should be maintained 1-64 inch below the surface of the commutator. To reduce the mica insulation use a small three-cornered file and care should be taken that the mica is reduced at the side of the slot neat to the bars as well as in the center.

Should the commutators become out of round, armature with commutators should be removed and the commutators turned true in a lathe. Use a sharp pointed tool for this operation and a very fine feed. Do not file. Finish its surface with fine sandpaper. After turning, the burrs between the copper bars should be removed, and the mica undercut with a three-cornered file as above. Do not allow cinders, dirt or grease to accumulate about the commutator or any part of the equipment.

Governor Unit The governor unit is composed of the two governor weights; the governor spring, the governor yoke and governor sleeve. They are attached to the inside face of the wheel with governor adjusting screw. The wheel is then balanced, after which one governor weight and one end of the governor yoke is marked with a small center punch. A corresponding center punch mark appears on the wheel, to guide, the repairman should he find it necessary to remove and replace them.

Should it be necessary to replace the governor unit or any of its parts, the wheel, with governor unit attached, should be rebalanced.

Governor Spring On all complete Turbo-Generators, the governor spring is tested and set for the proper speed under service load, before the equipment leaves the factory. It should, therefore, not be necessary to make further governor spring adjustment before the machine is placed in service.

On wheels and governor units shipped for repairs the governor spring is tested but not set.

It is therefore necessary to make the proper governor spring adjustment, after applying a new wheel, or governor unit, before placing the machine in service.

It is always advisable to check the governor valve adjustment when replacing a wheel or governor unit, as all compensation for anti-friction ring wear must be made by first adjusting the governor valve before making governor spring adjustments. (See speed regulation.)

Manufactured by

THE PYLE-NATIONAL COMPANY

General Offices and Works: 1334-13358 North Kostner Avenue, Chicago, Illinois, U.S.A.

INSTRUCTIONS FOR THE INSPECTION AND OVERHAUL OF ELECTRIC LIGHTING EQUIPMENT ON STEAM LOCOMOTIVES

	LOCOMOTIVE DEPOTS 4-WEEKLY	LOCOMOTIVE DEPOTS 8-WEEKLY	WORKSHOPS CLASS "A" OVERHAUL
EQUIPMENT	**LIGHT INSPECTION**	**HEAVY INSPECTION**	**OVERHAUL**
Turbo Generator Casting	----	----	Remove, dismantle. Clean casting in lye vat.†
" " Brush Gear	Examine for wear, spring tension and sticking brushes. See Note (1)	Examine for wear, spring tension and sticking brushes. See Note (1)	Clean - test insulation with 230 volt A.C. test lamp – adjust spring tension. See Note (1)
" " Armature	----	----	Test winding for short and open circuits. Test to earth with 230 volt A.C. test lamp. Clean, repair where necessary, pre-heat, varnish and bake. See Note (2)
" " Commutator	Examine	Examine and clean surfaces and slots if required, using a rag moistened with petrol or tetrachloride.† See Note (3) & (4)	After baking armature, turn commutator in lathe if required. Repeat test for armature after undercutting. See Note (4)
" " Field Coil	Examine leads	Examine leads. Examine coil for insulation deterioration or saturation with oil. See Note (5)	Remove, clean and test – preheat, varnish and bake – remove leads as required. Test to earth after re-assembly. Ensure field coil is firmly fitted.
" " Connections	Examine	Examine	Check and re-connect where necessary.
" " Turbine Rotor	----	See Note (6)	Clean, examine – replace defective rotor blades – check for worn or bent shaft and wheel alignment. Examine governor equipment and replace as required.
" " Governor Valve & Cage	Adjust if required. See Note (7)	Examine and replace worn or defective parts. Adjust if required. See Note (7)	Dismantle, examine, replace defective parts – ream out scale from cage – check valve cage for seating and grind in with paste. Clean valve. See Note (7)
" " Strainer	Remove and clean.	Remove and clean. Renew as required.	Clean or renew.
" " Ant-friction Ring	----	See Note (7)	Clean, check for wear and renew as required. See Note (7)
" " Bearings	Top up oil wells. See Note (8)	Drain, flush and refill oil wells. Check and renew bearings as required. See Note (8)	Clean, examine – replace when worn. Drain, clean and flush oil wells. Replace worn oil rings. Refill oil wells after assembly. See Note (8)
LIGHTS, FITTINGS, TERMINALS AND WIRING			
Lamp Fittings	Examine. See Note (12b)	Examine and clean. See Note (12b)	Remove, clean and examine – renew as required – clean insulating blocks. See Note (12a) & (12b)
Head and Tail Lamps	Examine and clean glasses. See Note (9), (10) & (11) Test spare lamps in holder provided in headlamp.	Examine and clean glasses and reflectors if required. Maintain & test spare lamps in holder provided in headlamp. See Note (9), (10) & (11)	Remove, clean, examine and repair. Replace defective terminal insulation. Paint interior white or aluminium. Replate reflectors if tarnished or worn. See Note (9) & (11)
Terminal Blocks and Switch Boards	----	Examine and clean Check terminal nuts for tightness.	Remove, clean insulation blocks and boards, switches and resistances – renew parts as required.
Wiring	Examine where accessible.	Examine where accessible.	Withdraw all wiring from conduit and replace, using approved heat resisting wire only. See Note (12a) & (12b)
Conduit	Examine flexible conduit.	Examine flexible conduit. Renew if defective.	Remove all conduit and blow out with air – replace where corroded or damaged. Ream out pipe ends and remove all burrs from flexible conduit. All conduit must be well painted.

† WARNING – These chemicals are dangerous and toxic. Recommended that safer (and better) modern cleaners be used.

NOTES

(1) Correct spring tension on brushes i.e. 1 to 1 ½ lbs measured at the tip of the spring, in the position at which it rests on the brush. Renew springs and brushes as required, and bed in brushes to commutator using sandpaper. Emery-cloth must not be used.

(2) After varnishing, the armature must be drained vertically and supported vertically in the baking oven, to allow the varnish to set evenly throughout the windings and prevent an excess of varnish on one side of the armature which may cause an out of balance.

(3) Commutators must not be trued at Depots unless a good lathe operated by a turner is available.

(4) After truing commutator, undercut mica by $^{1}/_{64}$" below surface of commutator. At Depots, undercutting of mica should not be attempted when locomotive is in service unless found necessary. Commutators are to be replaced when worn to $1^{7}/_{8}$" diameter.

(5) If the field coil insulation has deteriorated or is saturated with oil, the field coil is to be removed and replaced. The removed coil is to be forwarded to the Works Manager for repairs. Check field coils for looseness.

(6) When replacing an anti-friction ring at depots, examine turbine wheel and governor equipment, and replace parts as required.

(7) Speed and Voltage Adjustments :

Valve Adjustment : As wear takes place on the anti-friction ring, the speed and voltage will increase, necessitating adjustments to the governor valve.

To determine whether the governor valve is correctly adjusted, remove the valve cap and strainer and note the position of the valve in the cage. When properly adjusted, the top of the governor valve should be flush with the top of its cage, when the valve cage is held firmly in position.

To attain the correct valve position, adjust the nut on the top of the valve stem.

All adjustments should be made with the turbine rotor and cover in position. After adjustment, check voltage.

Anti-friction Ring Wear Limitations :

When the adjustment of the nuts on the valve stem have reached the wire key through the end of the valve stem, the anti-friction ring should be replaced.

Voltage Check : the voltage checks must be made with the full locomotive lighting load connected, but including one headlamp only. Adjust to give the following voltages:

Bench Test	30 volts when operated at a steam pressure of not less than 125 lbs per square inch.
On Locomotive	Not more than 32 volts when operating under full working steam pressure.

Governor Adjustments : If the required voltage is not obtained by adjusting the valve nuts, adjust the governor screws (turning each an equal amount) and check voltage and valve adjustment again.

(8) Locomotive cylinder oil only must be used for the bearings.

(9) Glass fronts and doors must be tight fitting to prevent steam and smoke tarnishing reflectors.

(10) At Depots, reflectors must be cleaned with a non-abrasive, non-caustic soap and hot water only, using a soft cloth. An approved silver polish may be used after cleaning.

(11) Focusing of Head Lamps :

Adjust the lamp with the focal-adjusting thumbscrews so as to reduce the beam to the smallest possible diameter at a distance of 50 ft to 70 ft from the locomotive. When adjusting the focus it is preferable to have the beam thrown against a wall or the end of a vehicle situated at the required distance from the locomotive. The beam should be central on a straight level track.

(12) Tests :

(a) When locomotive overhaul is completed, test wiring and fittings throughout using a 250 volt megger.

At least 500,000 ohms to earth should be obtained for an overall test with all switches on and lamps in position.

At least 500,000 ohms should be obtained between wires with all lamps out and the generator disconnected.

(b) Check turbo-generator, lights and switches for correct operation, under a full head of steam.

(13) Turbo-generators, or associated parts forwarded separately to the Works Manager for repairs must be overhauled and tested as set out above for the parts concerned.

INSTRUCTIONS FOR THE INSPECTION AND OVERHAUL OF ELECTRIC LIGHTING EQUIPMENT ON STEAM LOCOMOTIVES

NOTE RE TESTING SPARE LAMPS ADDED 19-6-53
NOTES RE LOOSE FIELD COILS ADDED 6.9.52

CHIEF MECHANICAL ENIGNEER DATE 14/4/51

FILE No 44/730/28L
SUPERSEDES DRG

NZR

w16522

Redrawn P McCallum; 19/12/2009
Warning note re use of toxic chemicals added

ELECTRIC-LIGHT EQUIPMENT ON LOCOMOTIVES

LUBRICATION

All oil wells must be filled with steam cylinder oil and the oil supply replenished as required. Oil must not be added while the turbine is running and filler caps must be kept closed to prevent grit and foreign matter from entering the bearings. The turbine bearing should be liberally oiled each trip and condensate drained from the cellars at frequent intervals. Lubrication of the equipment as above is carried out by the Engine Drivers or Depot staff.

STARTING

The steam supply should be turned on slowly, so that sufficient time is allowed for condensate to drain away through the drain pipe, and the turbine speeded up steadily in such a way that it attains its maximum working speed when the steam valve is fully opened. If the turbine does not start, examine the strainer and clear out any accumulation of pipe scale or foreign matter. All lights should be switched on when the turbine is working at full speed to ensure that all globes and fittings are in good order. The cab lights should burn with a bright yellow light when the turbine is working at full speed. And if the lights burn too brightly the steam valve should be throttled back and the generator booked for throttle adjustments.

FAULTS AND DEFECTS

If the lights are dull and the turbine will not attain the required speed, the cause may be one of the following.

(a) Steam pressure too low.
(b) Steam strainer choked. The governor valve cap should be removed and the obstruction blown out with steam.
(c) Governor valve out of adjustment and giving an insufficient opening for the admission of steam to the nozzles. The top of the valves should be flush with the top of the cage when the valve is in position in the turbine, and any variation in this level will affect the speed of the turbine.
(d) The governor valve is set too light and is cutting off steam before the turbine reaches full running speed.
(e) An obstruction is preventing the shaft from running freely.
(f) The generator is overloaded or there is a short circuit in the lamp fittings or wiring. In this case the turbine will have a heavy exhaust and the humming sound will be louder than usual.
(g) Turbine buckets not in alignment with the steam nozzle.

If the lights are dull but the turbine runs at the required speed the cause may be:

(a) A dirty of burnt commutator. A dirty commutator may be cleaned with a piece of mutton cloth moistened with petrol or carbon tetrachloride but a burnt commutator should be booked for attention.
(b) Brushes sticking in the brush holder and making a poor contact on the commutator. The brushes may be cleaned but altering the spring pressure must not be attempted.
(c) Mica insulation requires undercutting. The mica should be undercut by 1/64 in, Book defect for attention.
(d) Commutator out of true.
(e) Shunt field disconnected. In this case the lights will become dull as the amp load is decreased. The voltage on full load at full speed will be 17 volts when the shunt field is out of commission.

If an individual lamp will not light or lights intermittently but the turbine runs at the correct speed the cause may be one of the following:

(a) Lamp burnt out.
(b) Lamp loose in socket, or contacts dirty
(c) Terminal screws loose in lamp fittings or junction box.
(d) Broken wires.
(e) Defective or dirty switch contacts.

If none of the lamps will function and the turbine runs at the required speed the cause may be:

(a) Wires disconnected from generator.
(b) Brushes worn out.
(c) Brushes not making contact with commutator due to lack of spring pressure or sticking in the brush holders.
(d) Field coil connection broken or loose.
(e) Commutator dirty or burnt to such a degree that the brushes cannot make electrical contact with the commutator surface.
(f) Insulating fibre washers missing between brush holders and turbine frame or from the positive binding post on the bottom brush holder.

REFLECTORS

The headlight reflector must be kept clean by washing with non-abrasive, non-caustic soap and water, applied with a soft cloth to avoid scratching. The reflector should then be polished with an approved silver polish.

When polishing, always rub from the rim to the centre in a straight line and not in a circular movement.

The glass fronts, doors, and fittings must be kept clean and must fit tightly to prevent steam or smoke tarnishing the reflectors and cold air affecting the lamp.

TO FOCUS

Adjust the lamp with the focal adjusting thumbscrews so as to reduce the beam to the smallest possible diameter at a distance of 50-70 ft from the locomotive. When adjusting the focus, if is preferable to have the beam thrown against a wall or the end of a vehicle situated the required distance from the locomotive.

The beam should be central on a straight level track and should be directed so as to define objects at a distance of 1,000-1,500 ft.

ADJUSTMENT OF GOVERNOR VALVES.

The method of adjusting the governor valve is described in the following paragraph. This work may be done by Engine Drivers or depot repair staff.

At wear takes place on the anti-friction ring, the speed and voltage will increase, necessitating adjustment to the governor valve. This will be indicated by the cab lights becoming brighter than usual. To determine whether the governor valve in correctly adjusted, remove the valve cap and strainer and note the position of the valve in the cage. When properly adjusted the top of the governor valve should be flush with the outer edge of the cage. Before attempting any adjustment, make sure that the valve cage is firmly in position and not riding on the spring; otherwise a false position is indicated. All valve adjustments should be made with the turbine wheel and cover in position. After removing the valve and cage, adjust the valve-adjusting nut and lock-nut until the correct height of

valve is obtained. The valve and cage should be held firmly in position and the strainer removed while the adjustment is carried out, and the two valve nuts securely locked after the valve is adjusted.

MAINTENANCE.

It is essential that the electric-lighting equipment on locomotives be maintained in the best condition possible and Engine Drivers must report all defects in the lighting system as soon as they are detected.