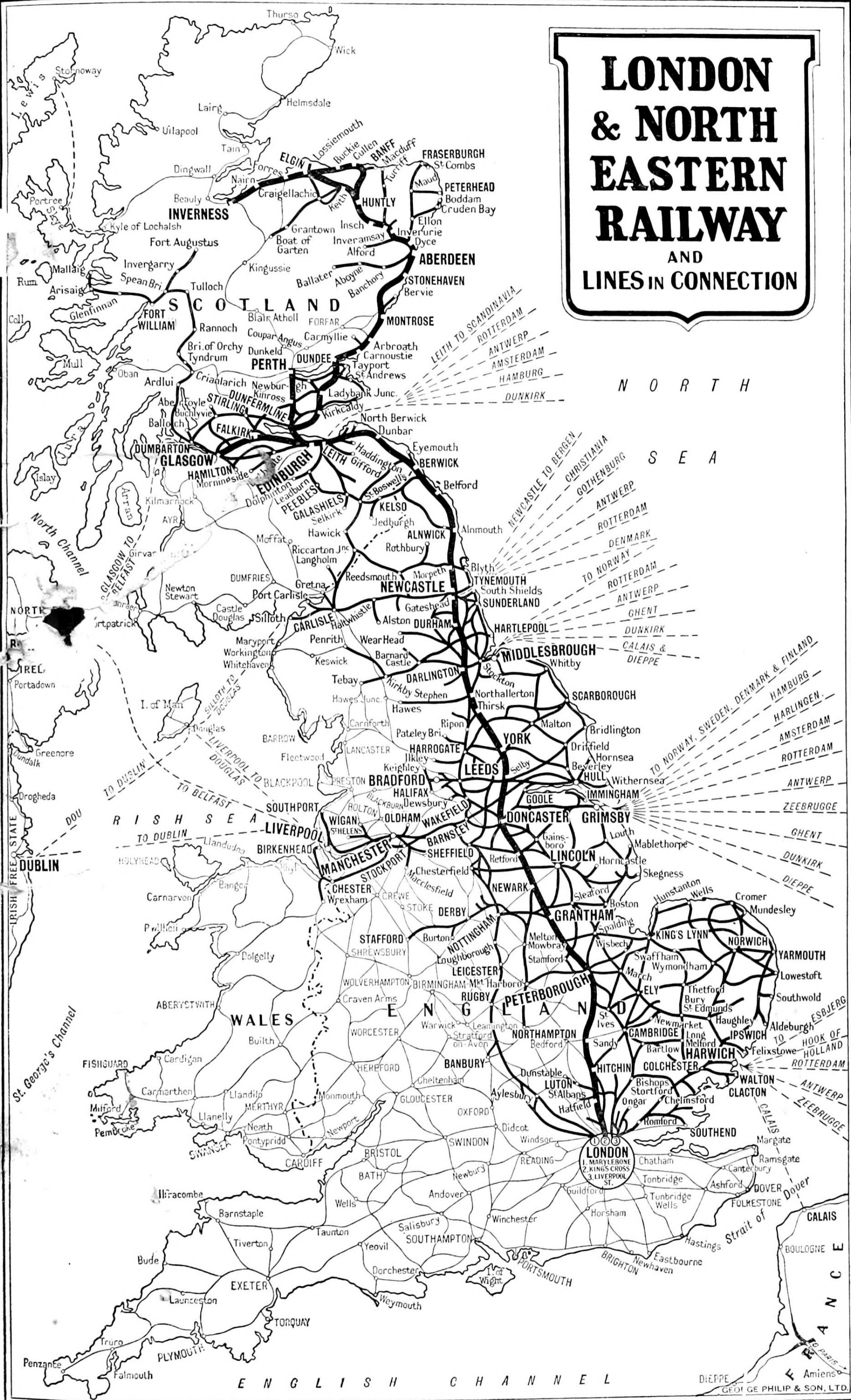


# LONDON & NORTH EASTERN RAILWAY AND LINES IN CONNECTION



N O R T H  
S E A

R I S H S E A

E N G L I S H C H A N N E L

GEORGE PHILIP & SON, LTD.

In 1922, there appeared the first of Mr H. N. Gresley's famous 4-6-2 Pacifics, the *Great Northern*, then numbered 1470, and later 4470 of the L.N.E.R. This locomotive was destined to become the forerunner of a class of one of the most famous and capable express locomotives in the country. With three cylinders of 20 in. diameter, a 26 in. stroke and a boiler of enormous size with 180 pound pressure, the *Great Northern* was indeed a revolutionary machine. It has since been rebuilt and is now No. 60113, of the North Eastern Region of British Railways.

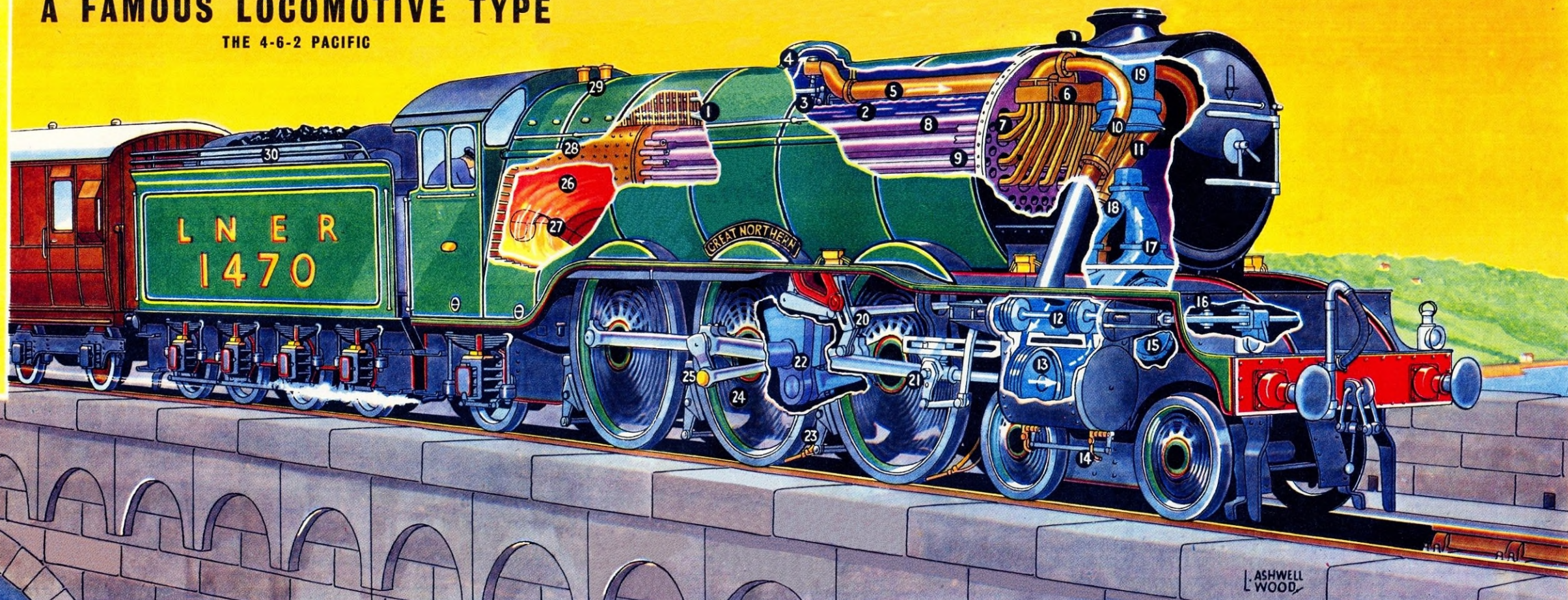
Many Pacifics have been built, and they now have a boiler pressure of 220 pounds per sq. in. Before the war, one of these, the *Gladiator*, hauled the 'Flying Scotsman' for 74 days on end, without even a minor defect, and covered 29,000 miles in three months. We show the *Great Northern* as it was in 1923, crossing the Royal Border Bridge, Berwick, which spans the River Tweed and forms a railway link between England and Scotland.

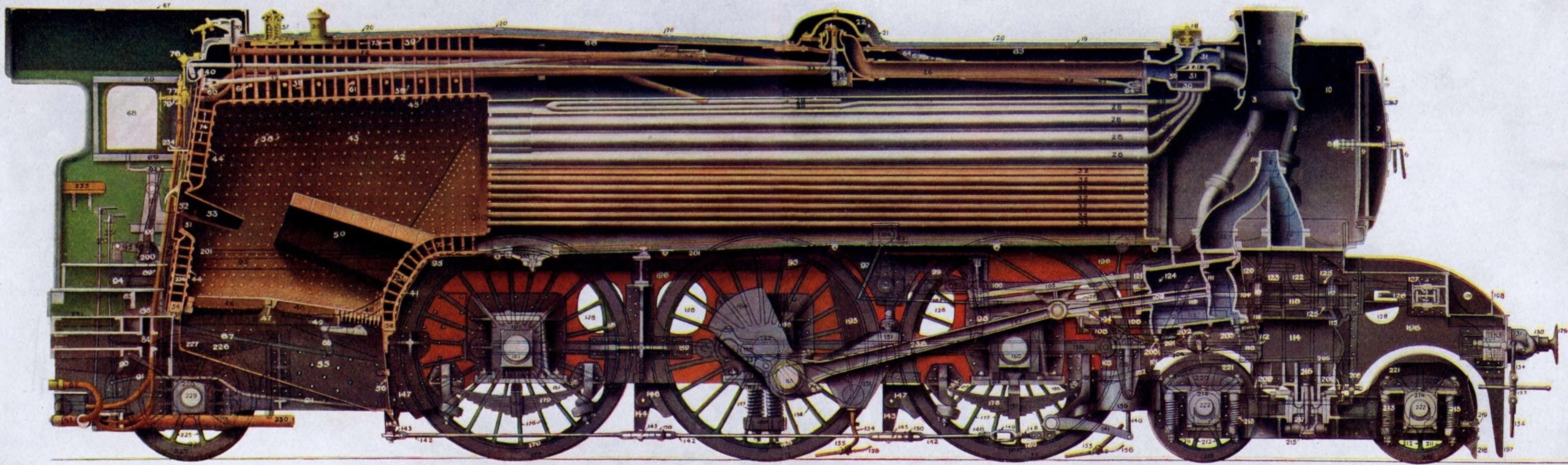
#### KEY TO PARTS

(1) Water supply from tender. (2) Water level over firebox. (3) Regulating rod from driver's cab. (4) Steam rises to this dome and is admitted by regulator valve to steam pipe. (5) Steam pipe to superheater. (6) Superheater header. (7) Steam passes back into boiler via these pipes (inside a flue) and returns superheated. (8) Superheater flue pipes. (9) Fire tubes from firebox, which heats the water. (10) Superheated steam pipe to outside cylinder (each side). (11) Superheated steam pipe to inside cylinder. (12) Piston valves, which control steam alternately either side of piston. (13) Piston on the forward stroke. (14) Cylinder condensed-water drain-cocks (used on starting). (15) Inside cylinder. (16) Rocker arm, working inside cylinder piston valves. (17) Exhaust from outside cylinders. (18) Exhaust from inside cylinder. (19) Chimney for exhaust steam and firebox gases. (20) Walschaert gear, for working outside cylinder piston valves. (21) Piston rod crosshead. (22) Inside connecting-rod and balance crank. (23) Brake blocks and sanding pipes. (24) Driving wheels; diameter, 6 ft. 8 ins. (25) Eccentric crank for valve gear. (26) Inside firebox. (27) Firedoor and brick arch. (28) Outside firebox. (29) Safety valves. (30) Tender coal-rails. Tender capacity - Coal, 8 tons; Water, 5,000 gallons.

## A FAMOUS LOCOMOTIVE TYPE

### THE 4-6-2 PACIFIC





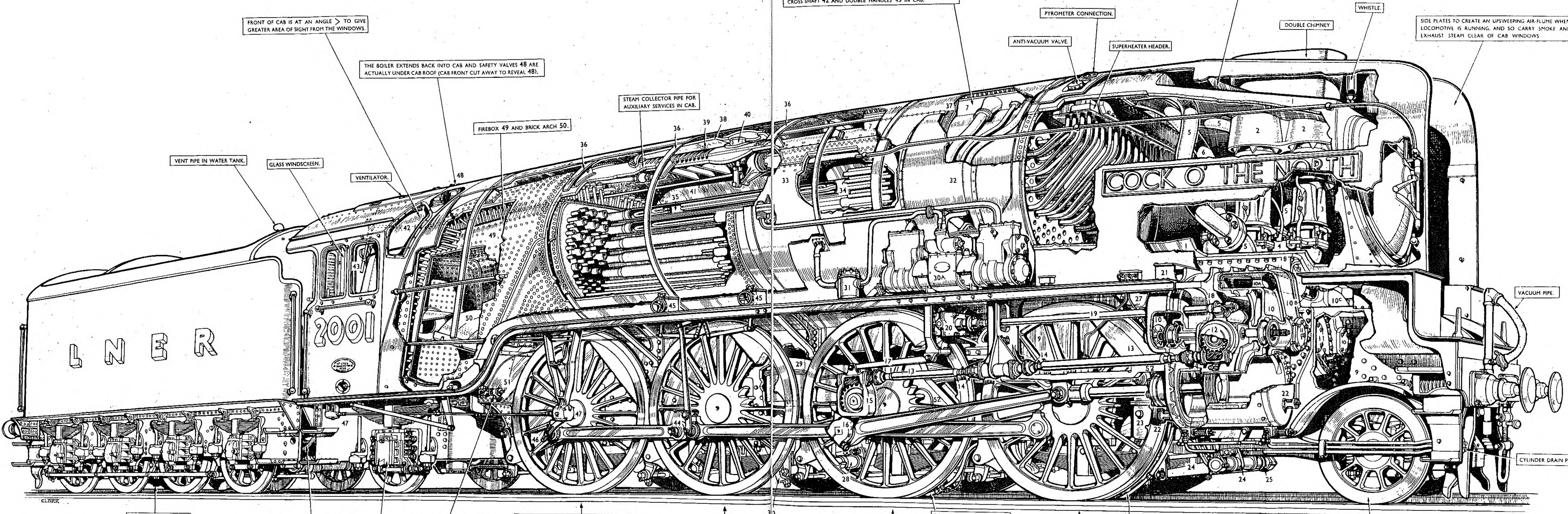
# LONDON AND NORTH EASTERN RAILWAY

## "COCK O' THE NORTH" 2-8-2 MIKADO TYPE EXPRESS PASSENGER LOCOMOTIVE No. 2001

(DESIGNED BY Mr. H. N. GRESLEY, C.B.E., CHIEF MECHANICAL ENGINEER)

OUTER CASING OF LOCOMOTIVE IS CUT AWAY TO SHOW BOILER SHELL 33 WHICH IS CUT AWAY TO SHOW SUPERHEATER ELEMENTS 34. AT 35 THE SUPERHEATER TUBES HAVE BEEN BROKEN TO SHOW THE ELEMENTS. 36 ARE THE OUTER CASING SUPPORTS AND UNDER THE CASING IS A THIN SKIN OF CORRUGATED ALUMINIUM FOIL LAYERS, SEEN AT 37, WHICH PROVIDES INSULATION. THE STEAM COLLECTOR 38 RECEIVES STEAM THROUGH SLOTS 39 IN THE BOILER BARREL. DRY STEAM COLLECTS HERE AND 40 IS THE MAIN REGULATOR VALVE, CONTROLLED THROUGH 41 FROM A CROSS SHAFT 42 AND DOUBLE HANDLES 43 IN CAB.

SIDE PLATE CUT AWAY TO REVEAL 1 BOILER SMOKE BOX, ALSO CUT AWAY TO REVEAL 2 CHIMNEYS, 3 BLAST PIPES, 4 BLOWER STEAM FOR MAINTAINING DRAUGHT WHEN ENGINE IS STANDING, 5 STEAM PIPES FROM SUPERHEATER, 6 EXHAUST FROM CYLINDER TO FEED HEATER 7 FIXED ON THE BOILER BARREL, 8 SADDLE TOP OF CYLINDER CASTING IN WHICH RESTS SMOKE BOX 1 (THE CYLINDER CASTING BEING CARRIED BY THE MAIN FRAMES 9) ALSO SHOWING SUPERHEATER HEADER AND TUBES TO BOILER ELEMENTS.



FRONT OF CAB IS AT AN ANGLE > TO GIVE GREATER AREA OF SIGHT FROM THE WINDOWS.

THE BOILER EXTENDS BACK INTO CAB AND SAFETY VALVES 48 ARE ACTUALLY UNDER CAB ROOF (CAB FRONT CUT AWAY TO REVEAL 48).

STEAM COLLECTOR PIPE FOR AUXILIARY SERVICES IN CAB.

FIREBOX 49 AND BRICK ARCH 50.

VENT PIPE IN WATER TANK.

GLASS WINDSCREEN.

VENTILATOR.

COCK O' THE NORTH

VACUUM PIPE.

CYLINDER DRAIN PIPES.

WATER PICK-UP GEAR.

VACUUM AND FEED WATER PIPES.

51 BOILER BLOW-OFF COCK.

4TH DRIVING WHEEL. A LINK IS TAKEN FROM CRANK PIN 46 TO SPEEDOMETER DRIVE 47.

TRAILING AXLE IS PROVIDED WITH RADIAL MOVEMENT IN FRAME.

3RD DRIVING WHEEL. A LINK IS TAKEN FROM CRANK PIN 44 TO DRIVE THE WAKEFIELD LUBRICATORS 45. THE LUBRICATORS AND DRIVE ARE ACTUALLY ON THE L.H. SIDE, BUT HAVE BEEN DRAWN ON THE R.H. TO REVEAL THEM.

2ND DRIVING WHEEL. SPOKES ARE CUT AWAY TO REVEAL BELL-CRANK LEVERS 28 OPERATING THE BRAKES FROM PAIR OF VACUUM CYLINDERS 29. THE SPRING SUPPORT 30 IS CUT AWAY TO SHOW LEVER 28 CONNECTED TO PISTON ROD FROM VACUUM CYLINDER 29. ON THE RUNNING BOARD IS THE FEED PUMP 30 AND STEAM SEPARATOR 31. CONNECTIONS FROM THE FEED HEATER 7 ARE BROUGHT DOWN AROUND THE SIDE OF THE BOILER, COVERED BY A COWLING 32.

52 CRANK AXLE AND MIDDLE CONNECTING ROD.

26A IS STEAM SANDING GEAR.

1ST DRIVING WHEEL. SPOKES ARE CUT AWAY TO REVEAL PAIR OF VACUUM CYLINDERS 23, OPERATING THROUGH LEVERS 24 AND 25 TO BRAKE BLOCKS ON 1ST AND 2ND DRIVERS. GRAVITY SANDING 26 FROM RESERVOIR 27 UNDER RUNNING BOARD.

ABOVE: THE THREE CYLINDERS ARE IN ONE SINGLE CASTING AND ARE EQUIPPED WITH ROTARY CAM-OPERATED POPPET VALVE GEAR. EACH CYLINDER HAS A STEAM INLET VALVE 10 AND STEAM EXHAUST VALVE 11, AT EACH END. THE VALVES ARE OPERATED BY PUSHP RODS AND CAMS. THE CAMS FOR STEAM AND EXHAUST VALVES (R.H. CYLINDER), AND EXHAUST VALVE (MID-CYLINDER), BEING ON ONE CAMSHAFT DRIVEN THROUGH WORM GEAR 12, PROPELLER SHAFT 13, FLEXIBLE COUPLINGS 14, WORM GEAR 15 AND CRANK 16. WORM WHEEL 15 IS ON THE AXLE CENTRE LINE AND CRANK 16 SWINGS AROUND IT, THUS ROTATING IT AT SAME R.P.M. AS DRIVING WHEELS. REACTION LINK 17 KEEPS GEAR 15 IN POSITION.

CUT-OFF AND REVERSE ARE EFFECTED BY SLIDING OTHER CAMS (ALL ON THE ONE CAMSHAFT) UNDER THE VALVE TAPPETS. THE CAMSHAFT IS SLID ALONG (ACROSS THE LOCO) BY RACK AND PINION (IN CASE 18) DRIVEN BY SHAFT 19. THE VALVES FOR L.H. CYLINDER AND STEAM VALVE OF MID-CYLINDER ARE OPERATED BY SIMILAR CAMSHAFT AND GEAR, DRIVEN OFF THE L.H. DRIVING WHEEL CRANK. ITS REVERSING SHAFT AND SHAFT 19 ARE COUPLED UP THROUGH BEVEL GEARS 20 AND A CROSS SHAFT (RUNNING ACROSS THE LOCO). THEN FROM THE BEVEL GEARS 20 ON L.H. SIDE, AN OPERATING SHAFT 1 TAPPEL TO HAND WHEEL IN CAB. 10A SHOWS THE INLET STEAM CHANNEL FROM THE STEAM CHEST 10A ABOVE THE VALVES FED BY PIPES 5 AND 5 AND FROM WHICH THE THREE PAIRS OF STEAM VALVES ARE SUPPLIED. THE STEAM SUPPLY TO L.H. CYLINDER CAN JUST BE SEEN AT 10. AND THE MID-CYLINDER IS REVEALED BY THE CUT AWAY OF FRAME 9 (UNDER 10B). THE CYLINDER CASTING ABOVE THE RUNNING BOARD IS COVERED BY A LIGHT STEEL BOX PART OF WHICH IS SHOWN AT 21.

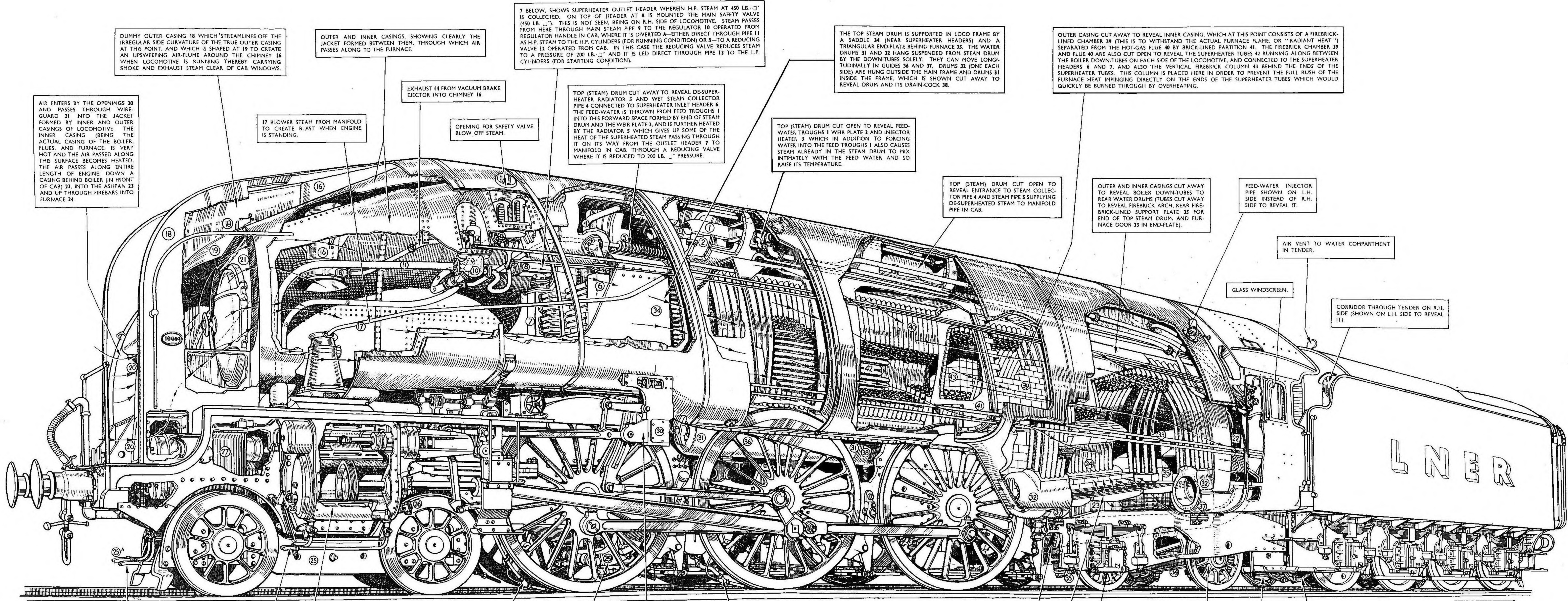
LEADING PONY TRUCK.

CLARK  
ENGINEERS LTD.  
M.A.C.H.E. E.P.Y.

# LONDON AND NORTH EASTERN RAILWAY

4-6-4 TYPE, 4-CYLINDER HIGH-PRESSURE COMPOUND LOCOMOTIVE No. 10000

(WITH YARROW-GRESLEY WATER-TUBE BOILER)



DUMMY OUTER CASING 18 WHICH STREAMLINES-OFF THE IRREGULAR SIDE CURVATURE OF THE TRUE OUTER CASING AT THIS POINT, AND WHICH IS SHAPED AT 19 TO CREATE AN UPSWEEPING AIR-FLOW AROUND THE CHIMNEY 16 WHEN LOCOMOTIVE IS RUNNING THEREBY CARRYING SMOKE AND EXHAUST STEAM CLEAR OF CAB WINDOWS.

OUTER AND INNER CASINGS, SHOWING CLEARLY THE JACKET FORMED BETWEEN THEM, THROUGH WHICH AIR PASSES ALONG TO THE FURNACE.

AIR ENTERS BY THE OPENINGS 20 AND PASSES THROUGH WIRE-GUARD 21 INTO THE JACKET FORMED BY INNER AND OUTER CASINGS OF LOCOMOTIVE. THE INNER CASING (BEING THE ACTUAL CASING OF THE BOILER, FLUES, AND FURNACE, IS VERY HOT AND THE AIR PASSED ALONG THIS SURFACE BECOMES HEATED. THE AIR PASSES ALONG ENTIRE LENGTH OF ENGINE, DOWN A CASING BEHIND BOILER (IN FRONT OF CAB) 22, INTO THE ASHPAN 23 AND UP THROUGH FIREBARS INTO FURNACE 24.

17 BLOWER STEAM FROM MANIFOLD TO CREATE BLAST WHEN ENGINE IS STANDING.

EXHAUST 14 FROM VACUUM BRAKE EJECTOR INTO CHIMNEY 16.

OPENING FOR SAFETY VALVE BLOW-OFF STEAM.

7 BELOW, SHOWS SUPERHEATER OUTLET HEADER WHEREIN H.P. STEAM AT 450 LB./SQ. IS COLLECTED. ON TOP OF HEADER AT 8 IS MOUNTED THE MAIN SAFETY VALVE (450 LB./SQ.). THIS IS NOT SEEN, BEING ON R.H. SIDE OF LOCOMOTIVE. STEAM PASSES FROM HERE THROUGH MAIN STEAM PIPE 9 TO THE REGULATOR 10 OPERATED FROM REGULATOR HANDLE IN CAB, WHERE IT IS DIVERTED—EITHER DIRECT THROUGH PIPE 11 AS H.P. STEAM TO THE H.P. CYLINDERS (FOR RUNNING CONDITION) OR 8—to A REDUCING VALVE 12 OPERATED FROM CAB. IN THIS CASE THE REDUCING VALVE REDUCES STEAM TO A PRESSURE OF 200 LB./SQ. AND IT IS LED DIRECT THROUGH PIPE 13 TO THE L.P. CYLINDERS (FOR STARTING CONDITION).

TOP (STEAM) DRUM CUT AWAY TO REVEAL DE-SUPERHEATER RADIATOR 5 AND WET STEAM COLLECTOR PIPE 4 CONNECTED TO SUPERHEATER INLET HEADER 6. THE FEED-WATER IS THROWN FROM FEED TROUGHS 1 INTO THIS FORWARD SPACE FORMED BY END OF STEAM DRUM AND THE WEIR PLATE 2. AND IS FURTHER HEATED BY THE RADIATOR 5 WHICH GIVES UP SOME OF THE HEAT OF THE SUPERHEATED STEAM PASSING THROUGH IT ON ITS WAY FROM THE OUTLET HEADER 7 TO MANIFOLD IN CAB, THROUGH A REDUCING VALVE WHERE IT IS REDUCED TO 200 LB./SQ. PRESSURE.

TOP (STEAM) DRUM CUT OPEN TO REVEAL FEED-WATER TROUGHS 1 WEIR PLATE 2 AND INJECTOR HEATER 3 WHICH IN ADDITION TO FORCING WATER INTO THE FEED TROUGHS I ALSO CAUSES STEAM ALREADY IN THE STEAM DRUM TO MIX INTIMATELY WITH THE FEED WATER AND SO RAISE ITS TEMPERATURE.

THE TOP STEAM DRUM IS SUPPORTED IN LOCO FRAME BY A SADDLE 34 (NEAR SUPERHEATER HEADERS) AND A TRIANGULAR END-PLATE BEHIND FURNACE 35. THE WATER DRUMS 31 AND 32 HANG SUSPENDED FROM STEAM DRUM BY THE DOWN-TUBES SOLELY. THEY CAN MOVE LONGITUDINALLY IN GUIDES 36 AND 37. DRUMS 32 (ONE EACH SIDE) ARE HUNG OUTSIDE THE MAIN FRAME AND DRUMS 31 INSIDE THE FRAME, WHICH IS SHOWN CUT AWAY TO REVEAL DRUM AND ITS DRAIN-COCK 38.

TOP (STEAM) DRUM CUT OPEN TO REVEAL ENTRANCE TO STEAM COLLECTOR PIPE 4 AND STEAM PIPE 5 SUPPLYING DE-SUPERHEATED STEAM TO MANIFOLD PIPE IN CAB.

OUTER CASING CUT AWAY TO REVEAL INNER CASING, WHICH AT THIS POINT CONSISTS OF A FIREBRICK-LINED CHAMBER 39 (THIS IS TO WITHSTAND THE ACTUAL FURNACE FLAME, OR "RADIANT HEAT") SEPARATED FROM THE HOT-GAS FLUE 40 BY BRICK-LINED PARTITION 41. THE FIREBRICK CHAMBER 39 AND FLUE 40 ARE ALSO CUT OPEN TO REVEAL THE SUPERHEATER TUBES 42 RUNNING ALONG BETWEEN THE BOILER DOWN-TUBES ON EACH SIDE OF THE LOCOMOTIVE, AND CONNECTED TO THE SUPERHEATER HEADERS 6 AND 7, AND ALSO THE VERTICAL FIREBRICK COLUMN 43 BEHIND THE ENDS OF THE SUPERHEATER TUBES. THIS COLUMN IS PLACED HERE IN ORDER TO PREVENT THE FULL RUSH OF THE FURNACE HEAT IMPINGING DIRECTLY ON THE ENDS OF THE SUPERHEATER TUBES WHICH WOULD QUICKLY BE BURNED THROUGH BY OVERHEATING.

OUTER AND INNER CASINGS CUT AWAY TO REVEAL BOILER DOWN-TUBES TO REAR WATER DRUMS (TUBES CUT AWAY TO REVEAL FIREBRICK ARCH, REAR FIREBRICK-LINED SUPPORT PLATE 35 FOR END OF TOP STEAM DRUM, AND FURNACE DOOR 33 IN END-PLATE).

FEED-WATER INJECTOR PIPE SHOWN ON L.H. SIDE INSTEAD OF R.H. SIDE TO REVEAL IT.

AIR VENT TO WATER COMPARTMENT IN TENDER.

GLASS WINDSCREEN.

CORRIDOR THROUGH TENDER ON R.H. SIDE (SHOWN ON L.H. SIDE TO REVEAL IT).

25 AND 25A ARE CYLINDER DRAIN-COCK PIPES. PIPES 25A ARE FROM H.P. CYLINDERS WHICH MAY BE SEEN INSIDE MAIN FRAME, CUT AWAY AT 27.

STEAM-SANDING-GEAR PIPE, SHOWING SMALL PIPE FROM CAB FOR EJECTING SAND DIRECTLY UNDER DRIVING WHEELS.

STEAM-SANDING-GEAR PIPE, SHOWING SMALL PIPE FROM CAB FOR EJECTING SAND DIRECTLY UNDER DRIVING WHEELS.

ASH-PAN DOOR (OPERATED FROM CAB).

1st TRAILING AXLE SUPPORTED (AND ALLOWED RADIAL MOVEMENT) IN FRAME.

INJECTOR OVERFLOW PIPE.

VACUUM AND FEED WATER PIPES

L.P. CYLINDER CUT OPEN TO SHOW PISTON AND PISTON-VALVE GEAR. NOTE INLET PORT IN VALVE CYLINDER AND RELIEF VALVES 28 IN MAIN CYLINDER END-COVERS TO RELIEVE ANY EXCESS PRESSURE OR CONDENSATE WATER.

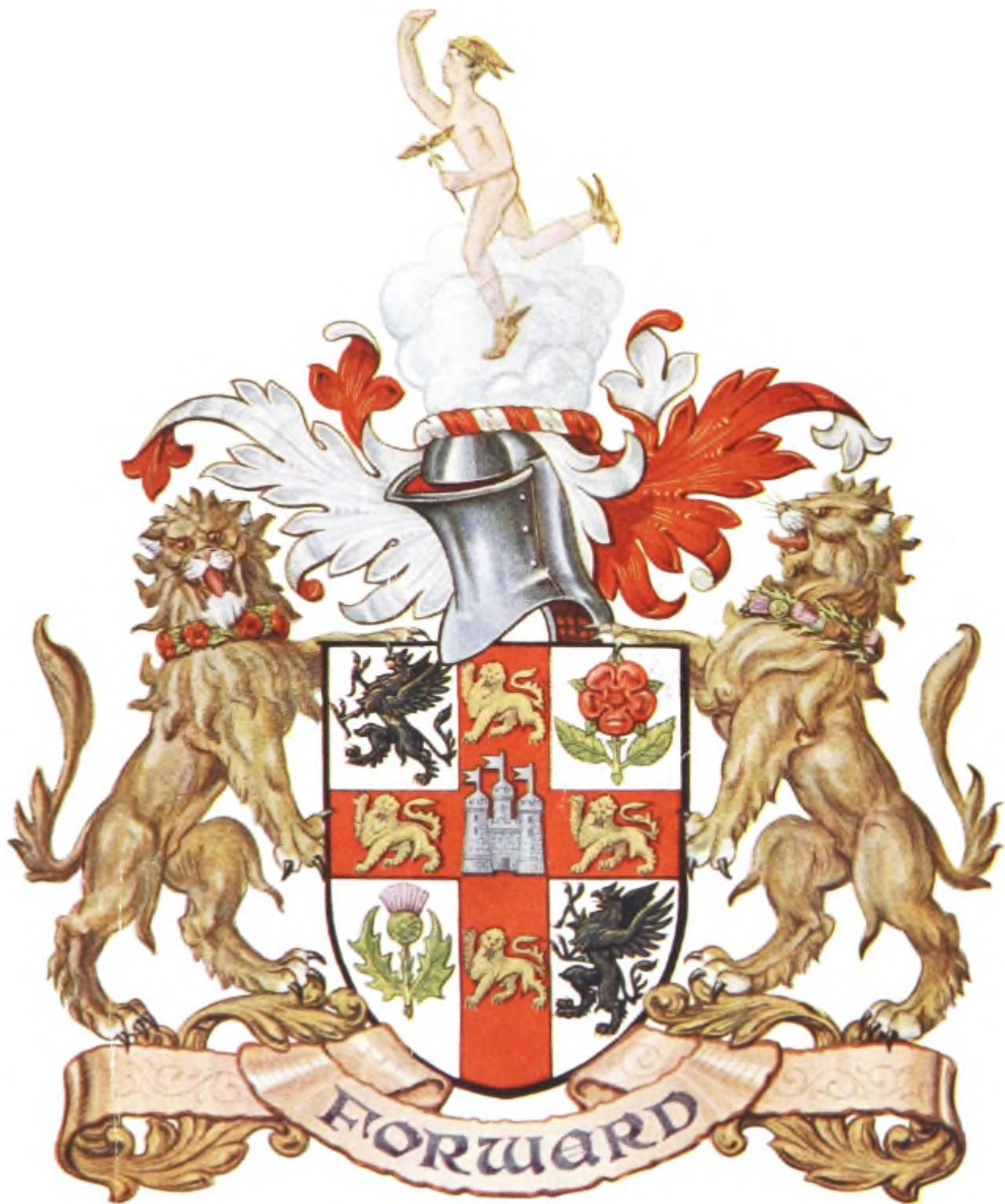
BRACKETS 29 CARRYING BRAKE SHAFT (WHICH IS OPERATED BY ARM CONNECTED TO STEAM-BRAKE CYLINDER SITUATED BETWEEN MAIN FRAMES) OPERATING THE PULL-RODS CONNECTED TO BRAKE BLOCKS AT COUPLED WHEELS.

BRACKET 30 CARRYING VALVE-GEAR RADIUS-LINK, AND MECHANICAL LUBRICATOR, CUT AWAY TO REVEAL FRONT WATER-DRUM 31 INSIDE MAIN FRAME WHICH IS ALSO CUT AWAY TO REVEAL WATER-DRUM. RADIUS-LINK (L.P.) OPERATED BY SCREW GEAR CARRIED IN TOP EXTENSION OF BRACKET 30. RADIUS-LINK (H.P.) OPERATED BY SCREW GEAR AND BEVEL DRIVE (SEEN IMMEDIATELY ABOVE L.P. CYLINDER CROSS-HEAD GUIDE) THE SCREW GEARS ARE ACTUATED FROM CAB, THROUGH RODS SEEN PASSING BETWEEN OUTER AND INNER CASINGS AT THE CUTAWAY SECTIONS.

REAR WATER-DRUM 32 CUT AWAY TO REVEAL ASHPAN 23 AND FIREBARS. NOTICE FOUR TUBES EACH SIDE OF FURNACE DOOR 33 FEED FROM HEADERS RUNNING OUT FROM REAR END OF WATER DRUMS.

2nd TRAILING AXLE ON A TRIANGULAR FRAME 34 WHICH SWINGS FREELY (INDEPENDENT OF MAIN FRAME) BEING PIVOTED AT THE POINT 35 JUST AHEAD OF 1st TRAILING AXLE.

HARRY CLARK



COAT OF ARMS  
LONDON AND NORTH EASTERN RAILWAY.