46 Internal-combustion engines; compressed-air, spring-actuated and other power engines

(46a Internal-combustion engines in general)

46a1 Gas engines, detonation or explosion engines, with self-ignition or ignition by external source

46a2 Internal-combustion piston engines for liquid fuels with self-ignition or ignition by external source inside the working cylinder

46a3 Internal-combustion piston-engines for solid fuels

46a4 Special types of the internal-combustion engines covered by 46a1 – 46a3

46a5 Internal-combustion engines with rotary pistons, oscillating vane-pistons, etc.

46a6 Fuels for internal-combustion engines as well as chemical and physical means to improve combustion in internal-combustion engines

46a7 Starting methods for internal-combustion piston engines

46a8 Ignition processes for internal-combustion piston engines

46a9 Charge, supercharge, and discharge pumps

46a10 Transmissions between pistons and drive shaft of internal-combustion engines with reciprocating pistons

46a11 Mass balancing, prevention and utilisation of vibrations in internal-combustion piston engines

46a (IPC: F02B) Internal-combustion piston engines; Combustion engines in general

(46b Valve gear and regulation of internal-combustion engines)

46b1 Valve gear for internal-combustion engines

46b2 Regulation of internal-combustion engines

46b (IPC: F02D) Controlling combustion engines

(46c Details of internal-combustion engines)

46c1 Pressure regulators, lubrication, valves, cylinders, pistons and related details of internal-combustion engines

46c2 Carburettors, vaporisers and mixers with accessories; means for fuel injection and feeding of fuel, gas generators

46c3 Ignition devices for internal-combustion engines

46c4 Cooling of internal-combustion engines

46c5 Means for starting internal-combustion engines

46c6 Exhaust arrangements and mufflers for internal-combustion engines

46c	**(IPC: F02M) Supplying combustion engines in general with combustible mixtures or constituents thereof**
46d	**Hot-gas piston engines, compressed-air piston engines, thermal piston engines with external combustion; recovery of waste heat and exhaust gases of thermal piston engines**
46d	**(IPC: F02G) Hot gas or combustion-product engine plants; Use of waste heat of combustion engines, not otherwise provided for**
46e	**Spring-actuated and gravity-actuated engines; engines for the use of the heat of the earth, water, air, or sun for power; gins**
46f	**Internal-combustion turbines: gas and oil turbines**
46f	**(IPC: F02C) Gas-turbine plants**
46g	**Mobile combustion reaction engines and fuels therefor**
46g	**(IPC: F02K) Jet-propulsion plants**
46h	**Heating and thermal power installations combined with piston engines and/or turbines and/or jet engines for general use**
46i	**(IPC: F02F) Cylinders, pistons, casings or crankcase ventilation for combustion engines; Arrangements of sealings in combustion engines**
46k	**(IPC: F02P) Ignition, other than compression ignition, for internal-combustion engines**
46l	**(IPC: F02N) Starting of combustion engines; Starting aids for such engines, not otherwise provided for**

46a1	**Gas engines, detonation or explosion engines, with self-ignition or ignition by external source**
46a1-1	Gas engines in general, e.g. acetylene, oxyhydrogen gas-engines, including operating processes
	Four-stroke cycle gas engines
46a1-4	in general, including operating processes
46a1-7	with means for the removal of combustion residues, i.e. exhausting
46a1-8	with means for charging and recharging
46a1-9	with means for compressing the charge
46a1-10	with means for improved combustion, combustion chambers
46a1-11	with means for improved transformation of heat into work during combustion and expansion -prolonged expansion, compounding, etc.
46a1-12	with means for several of the processes mentioned under 46a1-7 – 46a1-11
	Two-stroke cycle gas engines
46a1-15	in general, including operating processes
46a1-18	with means for the removal of combustion residues: exhausting, scavenging, or evacuation by suction
46a1-19	with means for charging and recharging
46a1-20	with receiver
46a1-21	Special arrangements of ports in two-stroke cycle gas engines
46a1-22	Two-stroke cycle gas engines with means for compressing the charge
46a1-23	with means for improved combustion, combustion chambers

46a1-24 with means for improved transformation of heat into work during the combustion/expansion stroke
46a1-25 with means for several of the processes mentioned under 46a1-18 – 46a1-24

46a2 Internal-combustion piston engines for liquid fuels, e.g. oils, with self-ignition or ignition by external source inside the working cylinder

Carburettor engines: oil engines working with compression of a mixture and ignition by external source inside the working cylinder; igniter, explosion or detonation engines using oil fuel

Carburettor engines in the stricter sense

46a2-1 Carburettor engines in general, including operating processes

Four-stroke cycle carburettor engines

46a2-4 in general, including operating processes
46a2-7 with means for removal of combustion residues
46a2-8 with means for charging and recharging
46a2-9 with means for compressing the charge
46a2-10 with means for improved combustion, combustion chambers
46a2-11 with means for improved transformation of heat into work during the combustion and expansion process: prolonged expansion, compounding, etc.
46a2-12 with means for several of the processes mentioned under 46a2-7 – 46a2-11

Two-stroke cycle carburettor engines

46a2-15 in general, including operating processes
46a2-18 with means for removal of combustion residues: exhausting, scavenging, or evacuation by suction
46a2-19 with means for charging and recharging
46a2-20 with receiver
46a2-21 Special arrangements of ports in two-stroke cycle carburettor engines
46a2-22 Two-stroke cycle carburettor engines with means for compressing the charge
46a2-23 with means for improved combustion - combustion chambers
46a2-24 with means for improved transformation of heat into work during the combustion/expansion stroke
46a2-25 with means for several of the processes mentioned under 46a2-18 – 46a2-24

Carburettor engines in the wider sense: with mixing of air and fuel inside the power cylinder

46a2-30 with fuel injection and atomising by compressed air or gas into the cylinder during the suction or compression stroke
46a2-32 with fuel injection and pressure atomising into the cylinder during the suction or compression stroke
46a2-33 with fuel injection and pressure atomising of a compressed mixture into the cylinder during the suction or compression stroke
46a2-34 with fuel injection and atomising by suction air into the cylinder
46a2-35 with fuel injection and atomising by compressed-air stream
46a2-36 with means for improved mixing inside the cylinder
46a2-37 with auxiliary explosion cylinder
46a2-44 Other carburettor engines in the wider sense

Diesel engines: internal-combustion engines working with compression of an air charge and self-ignition inside the power cylinder; constant pressure engines, combustion engines

Diesel engines in the stricter sense

46a2-45 Diesel engines in general, including operating processes

Four-stroke cycle diesel engines

46a2-48 in general, including operating processes
46a2-51 with means for removal of combustion residues
46a2-52 with means for charging and recharging
46a2-53 with means for compressing the charge
46a2-54 with means for improved combustion, combustion chambers
46a2-55 with means for improved transformation of heat into work during the combustion and expansion process: prolonged expansion, compounding, etc.
46a2-56 with means for several of the processes mentioned under 46a2-51 – 46a2-55

Two-stroke cycle diesel engines

46a2-60 in general, including operating processes
46a2-63 with means for the removal of combustion residues: exhausting, scavenging, or evacuation by suction
46a2-64 with means for charging and re-charging
46a2-65 with receiver
46a2-66 Special arrangements of ports in two-stroke cycle engines
46a2-67 Two-stroke cycle engines with means for compressing the charge
46a2-68 with means for improved combustion, combustion chambers
46a2-69 with means for improved transformation of heat into work during the combustion and expansion process - prolonged expansion, compounding, etc.
46a2-70 with means for several of the processes mentioned under 46a2-63 – 46a2-69

Diesel engines in the wider sense; engines similar to diesel engines, and semi-diesel engines

46a2-75 with simplified compressor attached to the power cylinder; injection air taken from the atmosphere or from the power cylinder
46a2-76 with injection air collector adjacent to the injection nozzle; injection air taken from the power cylinder
46a2-77 with mixture pump; fuel-air mixture compressed in pump cylinder, without self-ignition
46a2-78 with replacement of compressed injection air by exhaust gases, steam, or other pressure media

Diesel engines with solid injection ["airless injection"]

46a2-79/01 with undivided compression chamber
46a2-79/02 with divided compression chamber, particularly diesel engines with air-storage cell

Pre-chamber diesel engines, with partial combustion in a precombustion chamber

46a2-85 with high or medium compression, all the fuel stored in the precombustion chamber: ignition chamber, hot tube or hotpot, generally with moderately hot walls
46a2-86 with high or medium compression, all the fuel injected into the precombustion chamber; ignition chamber, hot tube or hot pot, generally with moderately hot walls
46a2-87 with medium or low compression, all the fuel stored in the precombustion chamber: ignition chamber, hot tube, hot bulb, hot pot, with red-hot walls
46a2-88 with medium or low compression, all the fuel injected into the precombustion chamber; ignition chamber, hot tube, hot bulb, hot pot, with red-hot walls
46a2-89 with plunger projection on the piston ["displacement engines"], all the fuel charge introduced into the precombustion chamber
46a2-90 with precombustion chamber periodically completely isolated from power cylinder
46a2-91 with auxiliary piston in the precombustion chamber: auxiliary piston for the transfer of the charge from the precombustion chamber into the power cylinder: "transfer engines"
46a2-95 with high or medium compression, part of fuel charge stored in the precombustion chamber, generally with moderately hot walls

46a2-96 with high or medium compression, part of fuel charge injected into the precombusion chamber, generally with moderately hot walls
46a2-97 with medium or low compression, part of fuel charge stored in the precombustion chamber, with red-hot walls
46a2-98 with medium or low compression, part of fuel charge injected into the precombustion chamber, with red-hot walls
46a2-99 with plunger projection of the piston ["displacement engines"], part of fuel charge introduced into the precombustion chamber
46a2-100 with precombustion chamber periodically completely isolated from power cylinder
46a2-101 with auxiliary piston in the precombustion chamber, part of fuel charge introduced into precombustion chamber

Oil engines of special design

Oil engines with compression of charge mixture and self-ignition

46a2-105/01 inside the power cylinder
46a2-105/02 inside auxiliary cylinder

46a2-107 Oil engines with compression of air charge and ignition inside cylinder by external source
46a2-109 Internal-combustion engines working as diesel engines, carburettor engines or gas engines
46a2-110 Diesel engines with compression of air charge outside the power cylinder

46a3 Internal-combustion piston-engines for solid fuels (14h-7/02)

46a3-1 Powdered-coal engines
46a3-2 Explosives engines
46a3-3 Engines for other solid fuels
46a3-4 Engines for solid fuels with liquid auxiliary fuel

46a4 Special types of the internal-combustion engines covered by 46a1 – 46a3

46a4-1 Single-cylinder engines
46a4-2 Engines with several parallel cylinders, or with groups of parallel cylinders

Engines with cylinders or groups of cylinders placed obliquely with respect to each other

46a4-3/01 V-engines
46a4-3/02 with cylinders in fan arrangement, W-engines
46a4-3/03 Radial engines with stationary cylinders
46a4-3/04 Other arrangements of cylinders

46a4-4 Engines with coaxial cylinders in tandem
46a4-5 Engines with coaxial opposed cylinders

Engines with opposite pistons in same cylinder

46a4-6/01 with pistons acting as valves
46a4-6/02 with pistons not acting as valves
46a4-6/03 with pistons working inside each other

46a4-7 Free piston engines
46a4-8 Engines with plunger pistons and cup pistons

Engines with positively driven auxiliary piston

46a4-9/01 with auxiliary piston apart from main piston
46a4-9/02 with auxiliary and main piston working inside each other
46a4-10 Free auxiliary piston engines

46a4-11 Engines with cylinders arranged in parallel in a circle around a central axis, engines with swash plate, etc.
46a4-12 Engines with adjustable cylinder
46a4-14 Special structures not mentioned under 46a4-1 – 46a4-12
46a4-15 Engines with oscillating cylinders

Rotary radial engines with crank
46a4-19/01 with stationary crank
46a4-19/02 with rotating crank and cylinders

46a4-23 Rotary radial engines with several cranks

Cam-type rotary radial engines
46a4-24/01 with internal contact cam surface
46a4-24/02 with external contact cam surface

46a4-25 Engines with rotating cylinders not arranged radially
46a4-26 Engines with rotating cylinders and induction and exhaust
46a4-27 Engines with rotating cylinders and external induction and exhaust
46a4-30 Engines with rotating cylinders of special structure not mentioned under 46a4-19 – 46a4-27
46a4-31 Arrangement and structure of valves and mixture admission systems for engines according to 46a4-15 – 46a4-30
46a4-34 Other particulars of engines according to 46a4-19 – 46a4-30 or 46a4-35
46a4-35 Arrangement of internal-combustion piston engines with auxiliary apparatus: blowers, dynamos, fuel pumps, etc.

46a5 Internal-combustion engines with rotary pistons, oscillating vane-pistons, etc. (gas turbines 46f; steam engines with rotary pistons 14b)

46a5-1 Engines with sliding abutments
46a5-2 Engines with vane pistons
46a5-3 Engines with rotary abutments
46a5-4 Engines with rotary members attached to the piston drum or disk

Engines with pistons
46a5-5/01 alternately rotating and stopped
46a5-5/02 alternately rotating faster and slower
46a5-6 Engines with pistons engaging in a gear-like manner
46a5-7 Engines with oscillating vane pistons, etc.
46a5-8 Engines with liquid ring
46a5-9 Special structures
46a5-10 Details

46a6 Fuels for internal-combustion engines as well as chemical and physical means to improve combustion in internal-combustion engines (14h-7/02; 46c2-34; 46c2-113; 46c4-7)

46a6-1 Addition of water or steam, in general
46a6-2 Mixing of cylinder charge with water or steam before entry into cylinder
46a6-3 Injection of water or steam into cylinder
46a6-4 Treatment of charge by catalysis, electrical processes, etc.
46a6-6 Use of other chemical substances to improve combustion
46a6-7 Fuels for internal-combustion engines (production: see special classes 12o, 23b; illuminating oils 23b-4/02; gaseous fuel, general, 26a-9, 26c-12; propellants for reaction engines 46g-20)

46a7 Starting methods for internal-combustion piston engines

46a7-1/01 Starting methods in general

46a7-1/02 Starting aids

46a8 Ignition processes for internal-combustion piston engines

46a8-1 Ignition processes in general

46a9 Charge, supercharge, and discharge pumps

Piston pumps for gas, air, and mixtures

46a9-1 Pump cylinders coaxial with power cylinders, behind or above the latter
46a9-2/01 Pump cylinder in front part of working cylinder, between power piston and crankcase
46a9-2/02 Crankcase pumps
46a9-3 Stepped piston pumps with annular pump space in front part of power cylinder
46a9-4 Pump cylinder concentric with power cylinder
46a9-5 Pump cylinder coaxial with power cylinder, arranged in front of latter beyond the crankshaft
46a9-6 Pump cylinder arranged beside power cylinder, with axes parallel
46a9-7 Pump cylinder arranged obliquely or at a right angle to power cylinder
46a9-8 Pump independent of engine, with separate drive
46a9-13 Injection pumps

Other pumps for gas, air, and mixtures

46a9-15 Centrifugal blowers
46a9-16 Rotary piston compressors (27c-1 – 27c-6)
46a9-17 Enclosed-type pumps, e.g. Roots blowers (27c-1 – 27c-6)
46a9-18 Miscellaneous blowers with rotating motion, except those mentioned above
46a9-22 Apparatus, in particular pumps, for evacuation of exhaust gases
46a9-23 Means for regulation of pumps
46a9-24 Special auxiliary devices for pumps according to 46a9-1 – 46a9-22

46a10 Transmissions between pistons and drive shaft of internal-combustion engines with reciprocating pistons (14a; 14h; 47h)

Cranks and similar drives

46a10-1/01 in general
46a10-1/02 for multi-cylinder engines
46a10-1/03 balanced by compressed air, liquid, or springs (47h-22; 46a4; 46a11-3; 46a10-9)
46a10-1/04 for engines with opposed pistons

46a10-2 Gear drives

Cam drives

46a10-3/01 Sliding cam drives
46a10-3/02 Crank, slot and guide

Transmissions with variable stroke

46a10-4/01 adjustable and changeable stroke
46a10-4/02 unequal piston strokes

Transmissions for engines with parallel cylinders arranged concentrically around a central axis according to subclass 46a4-11

46a10-5/01 with swash plates
46a10-5/02 with gear drives
46a10-5/03 with cam drives
46a10-5/04 Other transmissions

Transmissions for internal-combustion piston engines with rotary cylinders, according to subclass 46a4-11, 46a4-19 – 46a4-34

46a10-7/01 For radial engines without cams, cranks, etc.

46a10-7/02 For radial engines with cams
46a10-7/03 For cylinders in parallel to axis of rotation
46a10-7/04 Special drives not mentioned under 46a10-7/01 – 46a10-7/03
46a10-8 Transmissions for internal-combustion piston engines with pistons or cylinders rotating about their own axis
46a10-9 Special means of transmission (46a4-9; 47h-2; 47h-22)

46a11 Mass balancing, prevention and utilisation of vibrations in internal-combustion piston engines (14a; 14g-11; 42c-42; 42k-32; 42k-33; 47a-20; 47h-26; 63c; 65f2)

46a11-1 Balancing of masses in general
46a11-2 Prevention of torsional vibrations
46a11-3 Utilisation of vibrations
46a11-4 Mass balancing in engine units

46a (IPC: F02B) Internal-combustion piston engines; Combustion engines in general (plants in which engines use combustion products 46d, 14h; internal-combustion turbines 46f)

Engines characterised by the working fluid to be compressed, or characterised by the type of ignition (with both fuel-air mixture compression and air compression, or with both positive ignition and compression ignition 46a-11/00; with precombustion chambers 46a-19/00; having air-storage chambers 46a-21/00; with special shape or construction of other combustion chambers 46a-23/00)

46a-1/00 Engines with fuel-air mixture compression
46a-1/02 . with positive ignition (with non-timed positive ignition 46a-9/06)
46a-1/04 . . with fuel-air mixture admission into cylinder
46a-1/06 . . . Methods of operating
46a-1/08 . . with separate admission of air and fuel into cylinder
46a-1/10 . . . Methods of operating
46a-1/12 . with compression ignition (with fuel-air charge ignited by compression ignition of an additional fuel 46a-7/00)
46a-1/14 . . Methods of operating

46a-3/00 Engines with air compression and subsequent fuel addition
46a-3/02 . with positive ignition (with non-timed positive ignition 46a-9/06)
46a-3/04 . . Methods of operating
46a-3/06 . with compression ignition (46a-13/02 takes precedence; with fuel-air charge ignited by compression ignition of an additional fuel 46a-7/00)
46a-3/08 . . Methods of operating (46a-3/12 takes precedence)
46a-3/10 . . with intermittent fuel introduction
46a-3/12 . . . Methods of operating

46a-5/00 Engines with positive ignition (46a-1/02, 46a-3/02 take precedence; with non-timed positive ignition 46a-9/06)
46a-5/02 . Methods of operating

46a-7/00 Engines with fuel-air charge ignited by compression ignition of an additional fuel (with pre-combustion chambers 46a-19/00)
46a-7/02 . the fuel in the charge being liquid
46a-7/04 . . Methods of operating
46a-7/06 . the fuel in the charge being gaseous
46a-7/08 . . Methods of operating

46a-9/00 Engines characterised by other types of ignition
46a-9/02 . with compression ignition (46a-1/12, 46a-3/06 take precedence)
46a-9/04 . . Methods of operating
46a-9/06 . with non-timed positive ignition, e.g. with hot-spots
46a-9/08 . . with incandescent chambers

46a-9/10 . . . Chamber shapes or constructions

46a-11/00 Engines with both fuel-air mixture compression and air compression, or with both positive ignition and compression ignition, e.g. in different cylinders

46a-11/02 . convertible from fuel-air mixture compression to air compression or vice versa

Engines characterised by the method of introducing fuel into cylinders (characterised by use of gaseous or solid fuels 46a-43/00, 46a-45/00; carburettors, fuel-injection apparatus 46c**)**

46a-13/00 Engines with introduction of fuel into cylinders by use of auxiliary fluid

46a-13/02 . Compression ignition engines using air or gas for blowing fuel into compressed air in cylinder
46a-13/04 . . Arrangements or adaptations of pumps
46a-13/06 . Engines having secondary air mixed with fuel in pump, compressed therein without ignition, and fuel-air mixture being injected into air in cylinder
46a-13/08 . . Arrangements or adaptations of pumps
46a-13/10 . Use of specific auxiliary fluids, e.g. steam, combustion gas

46a-15/00 Engines characterised by method of introducing fuel into cylinders and not otherwise provided for

46a-15/02 . having means for sucking fuel directly into cylinder

46a-17/00 Engines characterised by means for effecting stratification of charge in cylinders

Engines characterised by having precombustion chambers or air-storage chambers, or characterised by shape or construction of combustion chambers to improve operation (engines with incandescent chambers 46a-9/08)

46a-19/00 Engines with precombustion chambers

46a-19/02 . the chamber being periodically isolated from its cylinder
46a-19/04 . . the isolation being effected by a protuberance on piston or cylinder head
46a-19/06 . with auxiliary piston in chamber for transferring ignited charge to cylinder space
46a-19/08 . the chamber being of air-swirl type
46a-19/10 . with fuel introduced partly into pre-combustion chamber, and partly into cylinder (46a-19/02 to 46a-19/08 take precedence)
46a-19/12 . with positive ignition (46a-19/02 to 46a-19/10 take precedence)
46a-19/14 . with compression ignition (46a-19/02 to 46a-19/10 take precedence)
46a-19/16 . Chamber shapes or constructions not specific to subgroups 46a-19/02 to 46a-19/10
46a-19/18 . . Transfer passages between chamber and cylinder

46a-21/00 Engines having air-storage chambers

46a-21/02 . Chamber shapes or constructions

46a-23/00 Other engines having special shape or construction of combustion chambers to improve operation

46a-23/02 . with compression ignition
46a-23/04 . . the combustion space being subdivided into two or more chambers (with pre-combustion chambers 46a-19/00)
46a-23/06 . . the combustion space being arranged in working piston (46a-23/04 takes precedence)
46a-23/08 . with positive ignition
46a-23/10 . . with separate admission of air and fuel into cylinder

Engines characterised by provisions for charging or scavenging (aspects concerned with driven charging or scavenging pumps 46a-33/00 to 46a-39/00)

46a-25/00 Engines using fresh charge for scavenging cylinders

46a-25/02 . using unidirectional scavenging
46a-25/04 . . Engines having ports both in cylinder head and in cylinder wall near bottom of piston stroke

46a-25/06 . . . the cylinder-head ports being controlled by working pistons, e.g. by sleeve-shaped extensions thereof
46a-25/08 . . Engines with oppositely-moving reciprocating working pistons
46a-25/10 . . . with one piston having a smaller diameter or shorter stroke than the other
46a-25/12 . . Engines with U-shaped cylinders, having ports in each arm
46a-25/14 . using reverse-flow scavenging, i.e. with both inlet and outlet ports arranged near bottom of piston stroke
46a-25/16 . . the charge flowing upward essentially along cylinder wall opposite the inlet ports
46a-25/18 . . the charge flowing upward essentially along cylinder wall adjacent the inlet ports, e.g. by means of deflection rib on piston
46a-25/20 . Means for reducing the mixing of charge and combustion residues or for preventing escape of fresh charge through outlet ports, not provided for in, or of interest apart from, subgroups 46a-25/02 to 46a-25/18
46a-25/22 . . by forming air cushion between charge and combustion residues
46a-25/24 . . Inlet or outlet openings being timed asymmetrically relative to bottom dead-centre
46a-25/26 . Multi-cylinder engines other than those provided for in, or of interest apart from, subgroups 46a-25/02 to 46a-25/24 (with movable cylinders 46a-57/00)
46a-25/28 . . with V-arrangement, fan-arrangement, or star-arrangement of cylinders

46a-27/00 Using kinetic or wave energy of charge in induction systems, or of combustion residues in exhaust systems, for improving quantity of charge or for increasing removal of combustion residues (use of driven apparatus for immediate conversion of combustion gas pressure into pressure of fresh charge 46a-33/42)
46a-27/02 . the systems having variable, i.e. adjustable, cross-sectional areas, chambers of variable volume, or like variable means (in exhaust systems only 46a-27/06)
46a-27/04 . in exhaust systems only, e.g. for sucking-off combustion gases
46a-27/06 . . the systems having variable, i.e. adjustable, cross-sectional areas, chambers of variable volume, or like variable means

46a-29/00 Engines characterised by other provisions for charging or scavenging; Details not provided for in, or of interest apart from, preceding groups 46a-25/00 and 46a-27/00
46a-29/02 . Other fluid-dynamic features of induction systems for improving quantity of charge (for also imparting a rotation to the charge in the cylinder 46a-31/00; structural features of induction systems 46c)
46a-29/04 . Cooling of air intake supply
46a-29/06 . After-charging, i.e. supplementary charging after scavenging
46a-29/08 . Modifying distribution valve timing for charging purposes (46a-29/06 takes precedence)

46a-31/00 Modifying induction systems for imparting a rotation to the charge in the cylinder (structural features of induction systems 46c)
46a-31/02 . in engines having inlet valves arranged eccentrically to cylinder axis

Engines characterised by provision of driven charging or scavenging pumps (introducing fuel into cylinders by air pressure 46a-13/00; after-charging 46a-29/06; arrangements for such pumps and other auxiliary apparatus on engines 46a-67/00; combined engine and pump control, control dependent on variables other than those generic to pump 46b)

46a-33/00 Engines with pumps for charging or scavenging (with pumps for sucking combustion residues from cylinders 46a-35/00; with exhaust-driven pumps 46a-37/00)
46a-33/02 . Engines with reciprocating-piston pumps; Engines with crankcase pumps
46a-33/04 . . with simple crankcase pumps, i.e. with the rear face of a non-stepped working piston acting as sole pumping member in co-operation with the crankcase
46a-33/06 . . with reciprocating-piston pumps other than simple crankcase pumps
46a-33/08 . . . with the working-cylinder head arranged between working and pumping cylinders

46a-33/10	. . . with the pumping cylinder situated between working cylinder and crankcase, or with the pumping cylinder surrounding working cylinder
46a-33/12	. . . . the rear face of working piston acting as pumping member and co-operating with a pumping chamber isolated from crankcase, the connecting-rod passing through the chamber and co-operating with movable isolating member
46a-33/14	. . . . working and pumping pistons forming stepped piston
46a-33/16	. . . . working and pumping pistons having differing movements
46a-33/18	. . . with crankshaft being arranged between working and pumping cylinders
46a-33/20	. . . with pumping-cylinder axis arranged at an angle to working-cylinder axis, e.g. at an angle of 90°
46a-33/22	. . . with pumping cylinder situated at side of working cylinder, e.g. the cylinders being parallel
46a-33/24	. . with crankcase pumps other than with reciprocating pistons only
46a-33/26	. . Four-stroke engines characterised by having crankcase pumps
46a-33/28	. . Component parts, details, or accessories of crankcase pumps not provided for in, or of interest apart from, subgroups 46a-33/02 to 46a-33/26
46a-33/30	. . . Control of inlet or outlet ports (controlling only working-cylinder inlets 14d)
46a-33/32	. Engines with pumps other than of reciprocating-piston type (with crankcase pumps 46a-33/02)
46a-33/34	. . with rotary pumps (with cell-type pressure interchangers or the like 46a-33/42)
46a-33/36	. . . of positive-displacement type
46a-33/38	. . . . of Roots type
46a-33/40	. . . of non-positive-displacement type
46a-33/42	. . with driven apparatus for immediate conversion of combustion gas pressure into pressure of fresh charge, e.g. with cell-type pressure exchangers
46a-33/44	. Passages conducting the charge from the pump to the engine inlet, e.g. reservoirs (cooling of charge after leaving pump 46a-29/04)
46a-35/00	**Engines with pumps for sucking combustion residues from cylinders**
46a-35/02	. using rotary pumps
46a-37/00	**Engines with exhaust-driven pumps** (passages conducting the charge from the pump to the engine inlet 46a-33/44)
46a-37/02	. Gas passages between engine outlet and pump drive, e.g. reservoirs
46a-37/04	. Engines with exhaust drive and other drive of pumps, e.g. with exhaust-driven pump and mechanically-driven second pump
46a-37/06	. . the pump being alternatively driven by exhaust and other drive; Control of this alternation, e.g. dependent on speed
46a-37/08	. Other control of such pumps
46a-39/00	**Component parts, details, or accessories relating to, but not provided for in, or of interest apart from, groups 46a-33/00 to 46a-37/00** (machine elements per se 47)
46a-39/02	. Drives of pumps (exhaust drives or combined exhaust and other drives 46a-37/00); Varying pump drive gear ratio (control acting both on engine and on pump drive gear ratio 46b)
46a-39/04	. . Mechanical drives; Variable-gear-ratio drives (non-mechanical pump drives having variable gear ratio 46a-39/08)
46a-39/06	. . . the engine torque being divided by a differential gear for driving a pump and the engine output shaft
46a-39/08	. . Non-mechanical drives, e.g. fluid drives having variable gear ratio
46a-39/10	. . . electric
46a-39/12	. . Drives characterised by use of couplings or clutches therein (using fluid slip couplings for varying gear ratio 46a-39/08)
46a-39/14	. Lubrication of pumps; Safety measures therefor
46a-39/16	. Other safety measures for, or other control of, pumps
46a-41/00	**Engines with special means for improving conversion of heat or pressure energy into mechanical power**
46a-41/02	. Engines with prolonged expansion
46a-41/04	. . in main cylinders
46a-41/06	. . in compound cylinders

46a-41/08 . . . Two-stroke compound engines
46a-41/10 . . in exhaust turbines (use of exhaust turbines for charging 46a-37/00; turbine constructions 14c; gas-turbine plant 46f)
46a-41/12 . . in jet-propulsion apparatus (plants characterised by jet propulsion 46g)

Engines operating on non-liquid fuels; Plants including such engines, i.e. combinations of the engine with fuel-generating apparatus (engines having gas-air charge ignited by compression ignition of an additional fuel 46a-7/06; engines convertible from gas to other fuel consumption 46a-69/04; apparatus for generating fuel, e.g. gas, see the relevant classes, e.g. 24e)

46a-43/00 Engines operating on gaseous fuels; Plants including such engines
46a-43/02 . Engines characterised by means for increasing operating efficiency
46a-43/04 . . for improving efficiency of combustion
46a-43/06 . . for enlarging charge
46a-43/08 . Plants characterised by the engines using gaseous fuel generated in the plant from solid fuel, e.g. wood
46a-43/10 . Engines or plants characterised by use of other specific gases, e.g. acetylene, oxyhydrogen
46a-43/12 . . Methods of operating

46a-45/00 Engines operating on other non-liquid fuels; Plants including such engines (plants involving generation of gaseous fuel from solid fuel 46a-43/08)
46a-45/02 . operating on powdered fuel, e.g. powdered coal (operating on fuel containing oxidant 46a-45/06)
46a-45/04 . . Plants, e.g. having coal-grinding apparatus
46a-45/06 . operating on fuel containing oxidant
46a-45/08 . operating on other solid fuels
46a-45/10 . operating on mixtures of liquid and non-liquid fuels, e.g. in pasty or foamed state

Methods of operating engines involving specific pre-treating of, or adding specific substances to, combustion air, fuel, or fuel-air mixture of the engines, and not otherwise provided for (apparatus for performing such pretreatments or additions 46c)

46a-47/00 Methods of operating engines involving adding non-fuel substances or anti-knock agents to combustion air, fuel, or fuel-air mixtures of engines
46a-47/02 . the substances being water or steam
46a-47/04 . the substances being other than water or steam only
46a-47/06 . . the substances including non-airborne oxygen (46a-47/10 takes precedence)
46a-47/08 . . the substances including exhaust gas
46a-47/10 . . . Circulation of exhaust gas in closed or semi-closed circuits, e.g. with simultaneous addition of oxygen

46a-49/00 Methods of operating air-compressing compression-ignition engines involving introduction of small quantities of fuel in the form of a fine mist into the air in the engine's intake

46a-51/00 Other methods of operating engines involving pre-treating of, or adding substances to, combustion air, fuel, or fuel-air mixture of the engines
46a-51/02 . involving catalysts
46a-51/04 . involving electricity or magnetism
46a-51/06 . involving rays or sound waves

Internal-combustion aspects of rotary-piston or oscillating-piston engines (general features 14b)

46a-53/00 Rotary-piston or oscillating-piston engines (rotary pistons or outer members for co-operation therewith 46a-55/00)
46a-53/02 . Methods of operating
46a-53/04 . Charge admission or combustion-gas discharge
46a-53/06 . . Valve control therefor

46a-53/08 . . Charging, e.g. by means of rotary-piston pump
46a-53/10 . Fuel supply; Introducing fuel to combustion space
46a-53/12 . Ignition
46a-53/14 . Adaptations of engines for driving, or engine combinations with, other devices (aspects predominantly concerning such devices, see the relevant classes for the devices)

46a-55/00 Rotary pistons; Outer members for co-operation therewith
46a-55/02 . Pistons
46a-55/04 . . Cooling thereof
46a-55/06 . . . by air or other gas
46a-55/08 . Outer members for co-operation with rotary pistons; Casings
46a-55/10 . . Cooling thereof
46a-55/12 . . . by air or other gas
46a-55/14 . Shapes or constructions of combustion chambers
46a-55/16 . Admission or exhaust passages in pistons or outer members

Internal-combustion aspects of reciprocating-piston engines with movable cylinders (general features 14a)

46a-57/00 Rotary engines in which the combusted gases displace one or more reciprocating pistons
46a-57/02 . Fuel or combustion-air supply (cylinder-charge admission or exhaust control 46a-57/04)
46a-57/04 . Control of cylinder-charge admission or exhaust (peculiar to two-stroke engines or to other engines with working-piston-controlled charge admission or exhaust 46a-57/06)
46a-57/06 . Two-stroke engines or other engines with working-piston-controlled cylinder-charge admission or exhaust (with combustion space in centre of star 46a-57/10)
46a-57/08 . Engines with star-shaped cylinder arrangements
46a-57/10 . . with combustion space in centre of star

46a-59/00 Other reciprocating-piston engines with movable, e.g. oscillating, cylinders (with yieldable walls 46a-75/38)

Adaptations of engines for special use; Combinations of engines with devices other than engine parts or auxiliaries (of rotary-piston or oscillating-piston engines 46a-53/14; aspects predominantly concerning such devices, see the relevant classes for the devices)

46a-61/00 Adaptations of engines for driving vehicles or for driving propellers; Combinations of engines with gearing (the engine torque being divided by a differential gear for driving a scavenging or charging pump and the engine output shaft 46a-39/06; arrangements in vehicles, see the relevant classes for vehicles)
46a-61/02 . for driving cycles
46a-61/04 . for driving propellers
46a-61/06 . Combinations of engines with mechanical gearing (46a-61/02, 46a-61/04 take precedence)

46a-63/00 Adaptations of engines for driving hand-held tools, electric generators, or pumps; Portable combinations with engine-driven devices
46a-63/02 . for hand-held tools
46a-63/04 . for electric generators
46a-63/06 . for pumps

46a-65/00 Adaptations of engines for other special use; Combinations of engines with other devices, e.g. with non-driven apparatus

Engines with pertinent characteristics other than those provided for in, or of interest apart from, preceding main groups

46a-67/00 Engines characterised by having specially-arranged auxiliary apparatus and not otherwise provided for, e.g. the apparatus having different

	functions; Driving auxiliary apparatus from engines, not otherwise provided for
46a-67/02	. with specially-arranged injection pumps and scavenging or charging pumps on V-engines
46a-67/04	. driving auxiliary apparatus mechanically
46a-67/06	. . by means of chains, belts, or like endless members
46a-67/08	. driving auxiliary apparatus non-mechanically
46a-69/00	**Internal-combustion engines convertible into other combustion-engine type, not provided for in group 46a-11/00; Internal-combustion engines of different types characterised by constructions facilitating use of same main engine-parts in different types**
46a-69/02	. for different fuel types, other than engines indifferent to fuel consumed, e.g. convertible from light to heavy fuel
46a-69/04	. . for gaseous and non-gaseous fuels
46a-69/06	. for different cycles, e.g. convertible from two-stroke to four-stroke
46a-71/00	**Free-piston engines; Engines without rotary main shaft**
46a-71/02	. Starting
46a-71/04	. Adaptations of such engines for special use; Combinations of such engines with apparatus driven thereby (aspects predominantly concerning driven apparatus, see the relevant classes for such apparatus)
46a-71/06	. . Free-piston combustion gas generators per se
46a-73/00	**Combinations of two or more engines, not otherwise provided for**
46a-75/00	**Other engines**
46a-75/02	. Engines characterised by their cycles, e.g. six-stroke
46a-75/04	. Engines with variable distances between pistons at top dead-centre positions and cylinder heads
46a-75/06	. Engines with means for equalising torque (compensations of inertial forces, suppression of vibration in systems 47a3)
46a-75/08	. Engines with means for preventing corrosion in gas-swept spaces
46a-75/10	. Engines with means for rendering exhaust gases innocuous (apparatus per se 14k)
46a-75/12	. Other methods of operation
46a-75/16	. Engines characterised by number of cylinders, e.g. single-cylinder engines (46a-75/26 takes precedence)
46a-75/18	. . Multi-cylinder engines (scavenging aspects 46a-25/00)
46a-75/20	. . . with cylinders all in one line
46a-75/22	. . . with cylinders in V-arrangement, fan-arrangement, or star-arrangement
46a-75/24	. . . with cylinders arranged oppositely relative to main shaft and of "flat" type
46a-75/26	. Engines with cylinder axes coaxial with, or parallel or inclined to, main-shaft axis; Engines with cylinder axes arranged substantially tangentially to a circle centred on main-shaft axis
46a-75/28	. Engines with two or more pistons reciprocating within same cylinder or within essentially coaxial cylinders (arranged oppositely relative to main shaft 46a-75/24)
46a-75/30	. . with one working piston sliding inside another
46a-75/32	. Engines characterised by connections between pistons and main shafts and not specific to preceding main groups
46a-75/34	. Ultra-small engines, e.g. for driving models
46a-75/36	. Engines with parts of combustion- or working-chamber walls resiliently yielding under pressure
46a-75/38	. . Reciprocating-piston engines (46a-75/04 takes precedence; with resiliently-urged auxiliary piston in pre-combustion chamber 46a-19/06)
46a-75/40	. Other reciprocating-piston engines
46a-77/00	**Component parts, details, or accessories, not otherwise provided for**
46a-77/02	. Surface coverings of combustion-gas-swept parts (of pistons or cylinders only 46i)
46a-77/04	. Cleaning of, preventing corrosion or erosion in, or preventing unwanted deposits in, combustion engines
46a-77/06	. Arrangements of purifying apparatus for liquid fuel or lubricant filters (restricted to lubricant-purifying apparatus 14i; restricted to liquid-fuel purifying apparatus 46c)

46a-77/08	. Safety, indicating, or supervising devices (thermal insulators 46a-77/12)
46a-77/10	. . Safety means relating to crankcase explosions
46a-77/12	. Thermal insulation
46a-77/14	. Engine-driven auxiliary devices combined into units
46a-79/00	**Running-in of internal-combustion engines** (lubrication thereof 14i)
46a-81/00	**(IPC: C10L 1/00) Liquid carbonaceous fuels for combustion engines**
46a-81/02	. essentially based on components consisting of carbon, hydrogen, and oxygen only
46a-81/04	. essentially based on blends of hydrocarbons
46a-81/06	. . for spark ignition
46a-81/08	. . for compression ignition
46a-81/10	. containing additives
	Note: **A compound is always classified in the last appropriate place. A metal salt or an ammonium salt of a compound is classified as that compound, e.g. a chromium sulphonate is classified as a sulphonate in 46a-1/24 and not in 46a-1/30.**
46a-81/12	. . inorganic compounds
46a-81/14	. . organic compounds
46a-81/16	. . . hydrocarbons
46a-81/18	. . . containing oxygen
46a-81/20	. . . containing halogen
46a-81/22	. . . containing nitrogen
46a-81/24	. . . containing sulphur, selenium and/or tellurium
46a-81/26	. . . containing phosphorus
46a-81/28	. . . containing silicon
46a-81/30	. . . containing elements not mentioned before
46a-81/32	. consisting of coal-oil suspensions and/or aqueous emulsions

46b1 Valve gear for internal-combustion engines

46b1-1/01	Valve gear in general
46b1-1/02	Valve gear for two-stroke cycle engines
46b1-2	Valve gear with compressed-air scavenging
46b1-3	Combined inlet and outlet valves
46b1-4	Control valves in the piston
46b1-5/01	Design of valve rods and cams
46b1-5/02	Damping devices on valve rods
46b1-6	Fuel valve gear
46b1-7	Controls for several valves, also valve systems
46b1-8	Controls for radial engines and engines with rotary pistons
46b1-9/01	Controls using pressure media
46b1-9/02	Controls using electric current
46b1-10/01	Cocks and rotary valve controls in general (14e-1 – 14e-4)
46b1-10/02	Rotary valves arranged on power piston
46b1-10/03	Rotary valves for two-stroke cycle engines
46b1-10/04	Sealings for rotary valves
46b1-11	Cocks and rotary valves with axis adjacent and parallel to the cylinder axes
46b1-12	Cocks and rotary valves with axis perpendicular to the cylinder axes
46b1-13	Tubular rotary valves coaxial with the cylinders
46b1-14	Cocks or disk-shaped rotary valves in cylinder head, with axes coinciding with those of cylinders (14e-6)
46b1-15	Rotary valves with rotary and reciprocating motion
46b1-16	Slide valve gears in general (14d)
46b1-17	Flat slide valve gears (14d-1; 14d-2)
46b1-18/01	Piston slide valve gears in general

46b1-18/02 Piston slide valve gears for two-stroke cycle engines
46b1-18/03 Packings for piston slide valves

Slide valves coaxial with cylinders
46b1-19/01 tubular and annular
46b1-19/02 semi-annular and the like
46b1-19/03 with drives combining two different motions

46b1-20 Control drive direct from crankshaft
46b1-21 Reversing mechanisms (14d; 65f2)
46b1-22 Compressed-air starting systems
46b1-23 Brake controls
46b1-24 Actuating controls
46b1-25 Means to reduce compression at starting

46b2 **Regulation of internal-combustion engines** (devices for regulation in general 42q, 42r)

Shutdown regulation
46b2-1/01 in general
46b2-1/02 as safety device
46b2-2 by pendulum
46b2-3/01 by keeping open the exhaust valve during the suction stroke, the intake valve being closed
46b2-3/02 by keeping gas inlet valve closed
46b2-3/03 by keeping mixture intake valve closed

Charge regulation
46b2-7/01 by mixture throttling during whole suction stroke
46b2-7/02 by mixture throttling governed by vacuum in suction line
46b2-7/03 by alternation of valve lift or by alteration of opening duration of intake valve
46b2-7/04 through anticipated closing of intake valve
46b2-7/05 through anticipated closing of exhaust valve
46b2-7/06 by expelling part of aspirated mixture

Mixture regulation, alteration of air/fuel ratio
46b2-8/01 through throttling of gas supply
46b2-8/02 by altering lift or duration of opening of intake valve
46b2-8/03 Regulation through simultaneous alteration of charge and mixture

Regulation of size of compression space
46b2-10 through alteration or displacement of piston stroke
46b2-11 through alteration of its volume, piston stroke unchanged

46b2-13 Designs of governor linkages, throttling arrangements, and centrifugal governors
46b2-14 Regulation of internal-combustion engines using several operating materials
46b2-15 Compressed injection air regulators
46b2-16 Regulators and their linkages for fuel injection pumps
46b2-17 Indirect regulation through special amplifiers, electromagnetic, hydraulic, etc.
46b2-18 Regulation dependent upon air pressure

Specific means for regulation
46b2-19/01 for mixture-compressing four-stroke cycle engines
46b2-19/02 for mixture-compressing two-stroke cycle engines
46b2-20/01 for air-compressing four-stroke cycle engines
46b2-20/02 for air-compressing two-stroke cycle engines

46b **(IPC: F02D) Controlling combustion engines** (cyclically operating valves for combustion engines 14d)

Controlling, e.g. regulating, fuel injection (peculiar to engines characterised by their use of non-liquid fuels, pluralities of fuels, or non-fuel substances added to the combustible mixtures 46b-19/00; peculiar to supercharged engines 46b-23/00; automatic controllers for prime movers, in general 42r2)

46b-1/00 **Controlling fuel-injection pumps, e.g. of high-pressure injection type** (controlling low-pressure fuel injection pumps 46b-3/00; controlling fuel injection electrically 46b-5/00)

46b-1/02 . not restricted to adjustment of injection timing, e.g. varying amount of fuel delivered
46b-1/04 . . by mechanical means dependent on engine speed, e.g. using centrifugal governors (46b-1/08 takes precedence)
46b-1/06 . . by means dependent on pressure of engine working fluid (46b-1/08 takes precedence)
46b-1/08 . . Transmission of control impulse to pump control, e.g. with power drive or power assistance
46b-1/10 . . . mechanical
46b-1/12 . . . non-mechanical, e.g. hydraulic
46b-1/14 . . . . pneumatic
46b-1/16 . Adjustment of injection timing (46b-1/02 takes precedence)
46b-1/18 . . with non-mechanical means for transmitting control impulse; with amplification of control impulse

46b-3/00 **Controlling low-pressure fuel injection, i.e. where the air-fuel mixture containing fuel thus injected will be substantially compressed by the compression stroke of the engine** (controlling fuel injection electrically 46b-5/00; carburettors 46c)

46b-3/02 . with continuous injection
46b-3/04 . Controlling fuel injection and carburetion, e.g. of alternative systems

46b-5/00 **Controlling fuel injection electrically**

46b-5/02 . with intermittent injection

46b-7/00 **Other fuel-injection control**

46b-7/02 . Controlling fuel injection where fuel is injected by compressed air

46b-9/00 **Controlling engines by throttling air or fuel-and-air induction conduits or exhaust conduits**

46b-9/02 . concerning induction conduits (throttle valves, or arrangements thereof in conduits 46b-9/08)
46b-9/04 . concerning exhaust conduits (throttle valves, or arrangements thereof in conduits 46b-9/08)
46b-9/06 . . Exhaust brakes
46b-9/08 . Throttle valves specially adapted therefor; Arrangements of such valves in conduits (throttle valves modified for use in, or arranged in, carburettors 46c; throttle valves in general 47g1)
46b-9/10 . . having pivotally-mounted flaps
46b-9/12 . . having slidably-mounted valve-members; having valve-members movable longitudinally of conduit
46b-9/14 . . . the members being slidable transversely of conduit
46b-9/16 . . . the members being rotatable
46b-9/18 . . having elastic-wall valve-members

46b-11/00 **Arrangements or adaptations of personal initial controls or control linkages** (specially for reversing 46b-27/00; specially for vehicles, see the relevant classes for vehicles)

46b-11/02 . of hand, foot, or like personal initial controls
46b-11/04 . of mechanical control linkages (with power drive or assistance 46b-11/06)
46b-11/06 . of non-mechanical, e.g. fluid, control linkages; of control linkages with power drive or assistance

46b-11/08 . . pneumatic
46b-11/10 . . electric

46b-13/00 Controlling the engine output power by varying inlet or exhaust valve operating characteristics, e.g. timing (modifying valve gear 14d)
46b-13/02 . during engine operation
46b-13/04 . . Using engine as brake
46b-13/06 . . Cutting-out cylinders
46b-13/08 . for rendering engine inoperative or idling

46b-15/00 Varying compression ratio (modifying valve-gear 14d)
46b-15/02 . by alteration or displacement of piston stroke
46b-15/04 . by alteration of volume of compression space without changing piston stroke

46b-17/00 Controlling engines by cutting-out individual cylinders; Rendering engines inoperative or idling (controlling or rendering inoperative by varying inlet or exhaust valve operating characteristics 46b-13/00)
46b-17/02 . Cutting-out (cutting-out engines in multiple-engine arrangements 46b-25/04)
46b-17/04 . rendering engines inoperative or idling, e.g. caused by abnormal conditions (dependent on lubricating conditions 14i-1/22; dependent on cooling 14l-5/14)

Controlling peculiar to specified types or adaptations of engines

46b-19/00 Controlling engines characterised by their use of non-liquid fuels, pluralities of fuels, or non-fuel substances added to the combustible mixtures (the non-fuel substances being gaseous 46b-21/00)
46b-19/02 . peculiar to engines working with gaseous fuels (apparatus, or control parts thereof, for mixing gas and air 46c)
46b-19/04 . peculiar to engines working with solid fuels, e.g. pulverised coal
46b-19/06 . peculiar to engines working with pluralities of fuels, e.g. alternatively with light and heavy fuel oil, other than engines indifferent to the fuel consumed
46b-19/08 . . simultaneously using pluralities of fuels (46b-19/12 takes precedence)
46b-19/10 . . . peculiar to compression-ignition engines in which the main fuel is gaseous
46b-19/12 . peculiar to engines working with non-fuel substances or with anti-knock agents, e.g. with anti-knock fuel (apparatus, or control parts thereof, for delivering such substances or agents 46c)

46b-21/00 Controlling engines characterised by their being supplied with non-airborne oxygen or other non-fuel gas
46b-21/02 . peculiar to oxygen-fed engines
46b-21/04 . . with circulation of exhaust gases in closed or semi-closed circuits
46b-21/06 . peculiar to engines having other non-fuel gas added to combustion-air
46b-21/08 . . the other gas being the exhaust gas of engine (circulation of exhaust gas in oxygen-fed engines 46b-21/04)
46b-21/10 . . having secondary air added to fuel-air mixture (apparatus, or control parts thereof, for delivering secondary air 46c)

46b-23/00 Controlling engines characterised by their being supercharged
46b-23/02 . the engines being of fuel-injection type

46b-25/00 Controlling two or more co-operating engines
46b-25/02 . to synchronise speed
46b-25/04 . by cutting-out engines

46b-27/00 Controlling engines characterised by their being reversible
46b-27/02 . by performing a programme

46b-29/00 Controlling engines peculiar to the devices driven thereby, the devices being other than parts or accessories essential to engine operation (aspects predominantly concerning control of driven devices, see the relevant classes for these devices)
46b-29/02 . peculiar to engines driving vehicles; peculiar to engines with conjoint control of engine and gearing; peculiar to engines driving variable-pitch propellers

46b-29/04 . peculiar to engines driving pumps
46b-29/06 . peculiar to engines driving electric generators

Other controlling of engines

46b-31/00 Using speed-sensing governors to control combustion engines, not otherwise provided for

46b-33/00 Controlling delivery of fuel or combustion-air, not otherwise provided for
46b-33/02 . of combustion-air

46b-35/00 Controlling engines, dependent on conditions exterior or interior to engines, not otherwise provided for
46b-35/02 . on interior conditions

46b-37/00 Controlling conjointly two or more functions of engines, not otherwise provided for
46b-37/02 . one of the functions being ignition (ignition control per se 46k)

46b-39/00 Other controlling
46b-39/02 . for four-stroke engines
46b-39/04 . for engines with other cycles than four-stroke, e.g. two-stroke
46b-39/06 . for engines adding the fuel substantially at end of compression stroke
46b-39/08 . for engines adding the fuel substantially before compression stroke
46b-39/10 . for free-piston engines; for engines without rotary main shaft

46c1 Pressure regulators, lubrication, valves, cylinders, pistons and related details of internal-combustion engines (pressure regulators, general 42q; valve structures 47g)

46c1-1 Pressure regulators
46c1-2 Lubrication (general 47e)
46c1-3 Intake and exhaust valves (46b1-1 – 46b1-7)
46c1-4 Cylinders and cylinder heads (14a-16; 47f-18)
46c1-5 Crankcases and casings
46c1-6 Internal-combustion engines fabricated from sheet metal elements
46c1-7 Packing for structural parts of internal-combustion engines (47f)
46c1-8 Pistons in general (47f)
46c1-9 Light-metal piston (47f)
46c1-10 Piston rings and oil wiper rings (47f)
46c1-11 Wrist pins
46c1-12 Connecting-rod heads, piston rods, flywheels, crankshafts (47b)
46c1-13 Valve removal and other tools, cleaning devices, openings for cleaning, etc.
46c1-14 Fuel and oil cleaners, filters (12d-23)
46c1-15/01 Safety arrangements (for starting 46c5) and indicating instruments (74b)
46c1-15/02 Safety arrangements and indicating instruments for lubrication
46c1-16/01 Arrangement and drive of auxiliary and accessory apparatus
46c1-16/02 Admission and exhaust pipes (exhaust dampers 46c6-1/10, spark extinguishers 24g-7/01)
46c1-16/03 Crankcase ventilation
46c1-16/04 Thermal insulation

46c2 Carburettors, vaporisers and mixers with accessories; means for fuel injection and feeding of fuel, gas generators

Jet carburettors

46c2-1 Jet carburettors of simplest type
46c2-2 Jet carburettors with mechanically adjustable main or additional air passage
46c2-3 Jet carburettors with automatically adjusted main or additional air passage

46c2-4	Independent additional air valves for jet carburettors, adjustable automatically or by mechanical means
46c2-5/01	Jet carburettors with mechanically adjustable fuel supply section
46c2-5/02	Jet carburettors with mechanically adjustable fuel supply section and connected air or mixture passage
46c2-6/01	Jet carburettors with automatically adjusted fuel supply section
46c2-6/02	Jet carburettors with automatically adjusted fuel supply and connected air or mixture passage
46c2-7	Carburettors with fuel supply section regulated by engine stroke
46c2-8	Carburettors with fuel supply section regulated by engine stroke and connected air or mixture passage
46c2-9	Valved carburettors with variable fuel intake and independently adjustable main air inlet
46c2-10	Valved carburettors with adjustable fuel inlet and dependent, variable main air intake
46c2-11	Valved carburettors with automatically adjustable connected fuel and air intakes
46c2-12	Intake and mixing valves for liquid fuels
46c2-13	Intake and mixing, valves for gaseous fuels (mixing valves, general 47g-20/02)
	Jet carburettors with compensating nozzles
46c2-14/01	with automatic compensating nozzles
46c2-14/02	with additional controlled nozzle
46c2-14/03	with compensation air nozzles [counterflow air] and air bubbling nozzles
46c2-14/04	with forked or return flow nozzles
46c2-14/05	with auxiliary fuel feed or pump
	Jet carburettors with other special systems for regulating fuel feed
46c2-15/01	Float chamber regulation
46c2-15/02	Miscellaneous regulation systems
46c2-16	Jet carburettors with progressive atomisation, except 46c2-12
46c2-17	Jet carburettors with progressive atomisation and blow tube
46c2-21	Jet carburettors with adjustable mixture passage cross section of simplest design
46c2-22	Jet carburettors with mechanically adjustable mixture passage cross section and dependent additional or main air passage cross section
46c2-23	Jet carburettors with automatically adjusted mixture passage cross section and dependent additional or main passage cross section
46c2-24	Jet carburettors with mechanically adjustable mixture cross section and dependent adjustable mixing throttle cross section
46c2-25	Jet carburettors with automatically adjusted mixture cross section and dependent adjustable mixing throttle cross section
46c2-26	Jet carburettors with mechanically adjustable mixing cross section and dependent adjustable fuel supply cross section and possibly also adjustable additional or main air passage
46c2-27	Jet carburettors as above, but with automatically adjusted mixture passage cross section
46c2-28	Jet carburettors with adjustable mixture passage cross section and jet orifice in throttle body, throttle valve carburettors
46c2-29	Jet carburettors with parallel mixing chambers
46c2-30	Jet carburettors with more than two parallel mixing chambers
46c2-31	Jet carburettors with two successive chambers in particular carburettors with two nozzles and idling jet opening at the throttle valve
46c2-32	Arrangements of two or more independent carburettors as per 46c2-29 – 46c2-31
46c2-33	Arrangements of two or more carburettors for two or more working fuels
	Carburettors with mixture enriched by special additives
46c2-34/01	Addition of water or steam

46c2-34/02 Addition of lubricating oil vapours or exhaust gases
46c2-34/03 Addition of acetylene, hydrogen, ozone, or other chemical substances

46c2-35 Mixture improvement by catalysis or by electrical means
46c2-40 Float arrangements and substitute structures: floats of various designs, float valves and means for their adjustment, etc.
46c2-41 Fuel and metering nozzles, nozzle cleaning
46c2-42 Air nozzles
46c2-43 Atomising heads and inserted turbulence elements
46c2-44 Regulator slide valves and throttles for carburettors
46c2-45 Adjusting gear for carburettors
46c2-46 Miscellaneous carburettor structures; different positions of axes of mixing chambers and floats in relation to each other
46c2-47 Starting carburettors
46c2-49 Air cleaners
46c2-50 Carburettors with fire protection devices

Particulars of suction lines

46c2-51/01 Mufflers (47f-1/01)
46c2-51/02 Various forms of suction connections

46c2-52 Miscellaneous details

Carburettors with preheater and vaporiser

46c2-56 Carburettors with preheating of fuel
46c2-57 Carburettors with preheating of air
46c2-58 Carburettors with preheating of mixture
46c2-59 Independently arranged fuel preheaters
46c2-50 Independently arranged air preheaters
46c2-51 Independently arranged mixture preheaters
46c2-52 Carburettors with fuel, air and mixture preheating
46c2-53 Carburettors with fuel, air and mixture preheating
46c2-54 Suction and exhaust lines, also exhaust mufflers used as air, fuel, or mixture preheaters
46c2-6 5 Cylinder heads and jackets as air, fuel, or mixture preheaters
46c2-66 Fuel vaporisers with air ad admixture before cylinder
46c2-67 Fuel vaporisers with air admixture inside cylinder
46c2-68 Fuel vapour generators as independent components
46c2-69 Suction and exhaust lines, cylinder heads and jackets as vaporisers
46c2-70 Carburettors and vaporisers inside the cylinder

Carburettors and vaporisers

46c2-71/01 with indirect heating
46c2-71/02 with preheating through combustion of fraction of the mixture
46c2-71/03 with mechanical production of heat, e.g. through surface friction

46c2-72 Electric heating arrangements for preheating of fuel, air or mixture, or vaporisation of fuel
46c2-73 Surface carburettors with liquid bath
46c2-74 Surface carburettors with wetted or trinkler surfaces
46c2-75 Surface carburettors with porous filler materials
46c2-76 Wick carburettors
46c2-77 Surface carburettors with rotating bodies
46c2-78 Means for intimate mixing in mixture line, fixed or movable
46c2-79 Compound mixture generators, in particular after-carburettors and after-vaporisers

46c2-82 Carburettors for molten fuels solid at normal temperatures, and melting arrangements therefor

46c2-83 Transformation of stored compressed or liquefied gases into a "ready for use" state before mixture (decantation and vaporisation of liquefied gases 17g-5/02)

Pressure carburettors

46c2-85 for two-stroke cycle engines, fuel atomising by pre-compressed combustion air

46c2-86 for four-stroke cycle engines, fuel atomising by pre-compressed combustion air

46c2-87 with pressure atomising of fuel inside suction line, with mechanically driven fuel pump

46c2-88 with pressure atomising of fuel, fuel pump driven by combustion air stream, pump nozzles

46c2-89 with fuel atomising by centrifugal force (46e2-77)

46c2-90 with compressed-air or compressed-gas atomising inside induction line

46c2-91 with pressure atomising of compressed mixture, mixture pump in mixing line, mixture pumps

Fuel-feeding means

46c2-94 Fuel feeding in general

46c2-95 Fuel suction devices

46c2-96 Fuel pumps in general

46c2-97 Diaphragm pumps (59a-35)

Means for fuel injection in diesel and semi-diesel engines

46c2-100 Means for injection with compressed-air atomising, compressed air supplied from the cylinder

46c2-101 Means for injection with compressed-air atomising, independent compressed-air source

46c2-102 Means for fuel injection with atomising by exhaust gases, steam, or other pressure media

46c2-103 Means for injection with pressure atomising, jet atomising

46c2-104 Means for fuel injection with fuel atomising through partial combustion

46c2-105 Fuel pumps for injection arrangements as per 46c2-100 – 46c2-104 with reciprocating piston or diaphragm

46c2-106 Fuel pumps for injection arrangements as per 46c2-100 – 46c2-104 with rotary pistons

46c2-107 Mixture pumps

46c2-108 Means for balancing of pressure for pumps as per 46c2-105 – 46c2-107

46c2-109 Details of pipe systems for pumps as per 46c2-105 – 46c2-107, e.g. means for venting

46c2-110 Open injection nozzles for arrangements as per 46c2-100 – 46c2-102

46c2-111 Closed injection nozzles for arrangements as per 46c2-100 – 46c2-102

46c2-112 Injection nozzles with ignition-oil feed as per 46c2-100 – 46c2-102

46c2-113 Injection nozzles with water feed as per 46c2-100 – 46c2-102

46c2-114 Injection nozzles for solid (pressure) injection

Special pump arrangements for apparatus as per 46c2-100 – 46c2-105

46c2-115/01 with feeding pump and main pump

46c2-115/02 Pumps with fuel distributors

46c2-115/03 Miscellaneous

46c2-120 Gas producers insofar as their operation depends directly upon operation of an internal combustion engine, in particular use of combustion or exhaust heat of engines for gasifying (other gas producers 24e; 26a – 26c)

46c3 Ignition devices for internal-combustion engines

Ignition current generators

Electromagnetic ignition generators

46c3-1/01 in general

46c3-1/02	with make and break armature
	Drives for electromagnetic ignition generators
46c3-2/01	Clutches, transmissions
46c3-2/02	Ratchet couplings
	Ignition generators
46c3-3	for engines with cylinder arranged in "V"
46c3-4	combined with illumination generator
46c3-5	with flywheel magnets
46c3-6	dynamoelectric
46c3-7	Components: armatures, insulators, collectors, etc.
46c3-8	with rotary conductors for magnetic lines of force
46c3-9	with special magnets, e.g. bell magnets
46c3-10	with multi-pole magnets
46c3-11	with special pole-shoe shapes
46c3-13/01	Ignition arrangements, circuits
46c3-13/02	Ignition arrangements with radiation protection (21a4-22)
46c3-14	Safety circuits for battery ignition
46c3-15	Double ignition with magneto and battery ignition
46c3-16	High-frequency ignition arrangements
	Means for regulation
46c3-17/01	for ignition, by centrifugal governor
46c3-17/02	through pressure or vacuum
46c3-18	Distribution and contact breakers, combined
46c3-19	Contact breakers per se
46c3-20	Distributors per se
	Igniters
46c3-22	Make-and-break ignition
46c3-23	Make-and-break ignition by piston
46c3-24	Ignition triggering by means of compression
46c3-26	Ignition occurring simultaneously at different places or in two separate cylinders ["double spark ignition"]
46c3-27	Safety, reserve, and stopping arrangements (46c3-14; 63c-71)
46c3-29	Battery ignition, vibrators, coils, thermo-element ignition
46c3-30	Hot bulb ignition and igniter cartridges
46c3-31	Friction and pyrophoric ignition
46c3-32	Flame ignition
46c3-33	Spark plugs in general
46c3-34	Electromagnetic spark plugs
46c3-35	Leads for sparkplugs (21c-20 – 21c-26)
46c3-36	Protective covers for spark plugs, plug holders
46c3-37	Plug wrenches, combination wrenches (87c)
46c3-38	Interchangeable plugs, also during engine operation
46c3-39	Spark plugs with ventilation, electrode cleaning, fuel feeding, etc.
46c3-40	Spark plugs in special arrangements
46c3-41	Spark plugs with loose ball electrodes
46c3-42	Spark plug cleaners
46c3-43	Spark plugs with movable electrode ends
46c3-44	Multi-spark plugs
46c3-45	Cooled spark plugs
46c3-46	Spark plug with bayonet lock

46c3-47 Spark plug sockets
46c3-48 Plug with visible spark
46c3-49 Series sparks in plug
46c3-50 Series sparks in plug lead
46c3-51 Quartz insulation for spark plugs
46c3-52 Adjustable spark gap in plug
46c3-53 Plug testers
46c3-54 Plug testers with vacuum or inert gas tubes
46c3-55 Spark amplifiers and test circuits
46c3-56 Heated spark plugs
46c3-57 Mica insulation
46c3-58 External spark-plug electrode fixed to insulation
46c3-59 Glow plugs
46c3-60/01 Insulation for spark plugs made of ceramic materials (production of material 80b-7, 80b-8, 80b-12)
46c3-60/02 Specific ways of fixing insulation by cementing, etc.
46c3-61 Spark plugs with several insulated electrodes
46c3-62 Spark plugs combined with other devices

46c4 **Cooling of internal-combustion engines** (radiators, only when modifying, or being modified by, motor vehicle or aircraft structures 63c-72, 62e-13/01)

46c4-1 Cylinder air-cooling and form of cooling fins in engines
46c4-2 Piston and valve air-cooling
46c4-3 Cylinder liquid and water cooling
46c4-4 Piston and valve liquid and water cooling
46c4-5 Evaporation cooling
46c4-6 Open radiators
46c4-7 Miscellaneous cooling devices
46c4-8 Tube-type coolers and recoolers
46c4-9 Cell-type coolers
46c4-10 Coolers with interchangeable elements
46c4-11 Structural features of radiators and radiator accessories, e.g. filler pipes
46c4-12 Safety arrangements for cooling and means for indicating state of coolant
46c4-13 Means for regulating coolant circulation
46c4-14 Regulation of air passing through cooler by means of baffles
46c4-15 Means for heating the cooling water
46c4-16 Arrangements for cooling-water pumps (structure 59a, 59b) and for fans (structure 27c)
46c4-17 Ice-preventing cooling water mixtures

46c5 **Means for starting internal-combustion engines** (21d; 46a; 46b; 47h; 63e; 63k)

46c5-1 Means for mechanical starting, crank handles, racks, etc.
46c5-2 Means for starting with pull rope and coiling spring
46c5-3 Means for hand-starting with energy accumulator
46c5-4 Spring-actuated starting arrangements
46c5-5 Safety crank handles (35c)
46c5-6 Other starting safety arrangements
46c5-7 Compressed-air starting systems (46d)
46c5-8 Starting of engine through charging with mixture and igniting
46c5-10 Charging with acetylene for starting

46c5-11	Powder for starting
46c5-11/50	Special auxiliary arrangements for means as per 46c5-8 – 46c5-11
46c5-12/01	Electric starters combined with illumination generator; motor generators
46c5-12/02	Electric starters with planetary gearing
46c5-12/03	Electric starters with sliding armature
46c5-13	Electric starters with flywheel mass
46c5-14	Circuits and safety devices for electric starters
46c5-15	Starting, illumination and ignition machines
46c5-16	Pinion engagement for electric starters
46c5-17	Pivoting pinions for electric starters
46c5-18	Electric starters with friction drive
46c5-19	Electric starters with external current or power supply, mobile and portable starting sets

46c6 Exhaust arrangements and mufflers for internal-combustion engines

46c6-1/01	Mufflers in general
46c6-1/02	Muffling through aspiration of fresh air
46c6-1/10	Exhaust dampers (exhaust lines 46c1-16/02)
46c6-1/11	Exhaust arrangements for multi-cylinder internal-combustion engines
46c6-1/12	Exhaust arrangements for radial engines
46c6-2	Mufflers with moving parts
46c6-3/01	Baffle-type mufflers, in general
46c6-3/02	Baffle-type mufflers, with helical or spiral turns
46c6-5	Recovery of exhaust gases for signalling, for vacuum cleaners, etc.
46c6-6/01	Mechanical purification and cooling of exhaust gases
46c6-6/02	Chemical and catalytic purification of exhaust gases (12e-3; 12g-4)

46c (IPC: F02M) Supplying combustion engines in general with combustible mixtures or constituents thereof (charging such engines 46a)

Carburettors (for gaseous fuels 46c-21/00; combined with low-pressure fuel-injection apparatus 46c-71/00)

46c-1/00	**Carburettors with means for facilitating engine's starting up or its idling below operational temperatures**
46c-1/02	. the means to facilitate starting being chokes for enriching fuel-air mixture (automatic chokes 46c-1/08)
46c-1/04	. the means to facilitate starting or idling being auxiliary carburetting apparatus able to be put into, and out of, operation, e.g. having automatically-operated disc valves
46c-1/06	. . having axially-movable valves, e.g. piston-shaped
46c-1/08	. the means to facilitate starting or idling becoming operative or inoperative automatically (in connection with auxiliary carburetting apparatus 46c-1/04)
46c-1/10	. . dependent on engine temperature, e.g. having thermostat
46c-1/12	. . . with means for electrically heating thermostat
46c-1/14	. . dependent on pressure in combustion-air or fuel-air-mixture intake (46c-1/10 takes precedence)
46c-1/16	. Other means for enriching fuel-air mixture during starting; Priming cups; Using different fuels for starting and normal operation
46c-1/18	. . Enriching fuel-air mixture by depressing float to flood carburettor
46c-3/00	**Idling devices** (with means for facilitating idling below operational temperatures 46c-1/00)
46c-3/02	. Preventing flow of idling fuel
46c-3/04	. . under conditions where engine is driven instead of driving, e.g. driven by vehicle running down hill

46c-3/06 . Increasing idling speed
46c-3/08 . Other details of idling devices (fighting ice-formation by heating idling ports 46c-15/02)

46c-5/00 Float-controlled apparatus for maintaining a constant fuel level
46c-5/02 . with provisions to meet variations in carburettor position, e.g. upside-down position in aircraft
46c-5/04 . . with pivotally or rotatably mounted float chambers (basic adjustment of float chambers having variable position 46c-5/14)
46c-5/06 . having adjustable float mechanism, e.g. to meet dissimilarities in specific gravity of different fuels
46c-5/08 . having means for venting float chambers
46c-5/10 . having means for preventing vapour lock, e.g. insulated float chambers or forced fuel circulation through float chamber with engine stopped
46c-5/12 . Other details, e.g. floats, valves (floats in general 47g1-33/00)
46c-5/14 . . Float chambers, e.g. adjustable in position

46c-7/00 Carburettors with means for influencing, e.g. enriching or keeping constant, fuel-air ratio of charge under varying conditions (choke valves for starting 46c-1/00)
46c-7/02 . Carburettors having aerated fuel spray nozzles (with valve control for amount of air for aerating fuel 46c-7/24)
46c-7/04 . Means for enriching charge at high combustion-air flow
46c-7/06 . Means for enriching charge on sudden air throttle opening, i.e. at acceleration
46c-7/08 . . using pumps
46c-7/10 . Other installations, without moving parts, for influencing fuel-air ratio
46c-7/12 . Other installations, with moving parts, for influencing fuel-air ratio, e.g. having valves
46c-7/14 . . with means for controlling cross-sectional area of fuel spray nozzle (dependent on air-throttle position 46c-7/22)
46c-7/16 . . . operated automatically
46c-7/18 . . with means for controlling cross-sectional area of fuel-metering orifice (dependent on air-throttle position 46c-7/22)
46c-7/20 . . . operated automatically, e.g. dependent on altitude
46c-7/22 . . fuel flow cross-sectional area being controlled dependent on air-throttle-valve position (the throttle valve being slidably arranged transversely to air passage 46c-9/06)
46c-7/24 . . with means for controlling amount of air for aerating fuel

46c-9/00 Carburettors having air or fuel-air mixture passage throttling valves other than of butterfly type (register-type carburettors 46c-11/00)**; Carburettors having fuel-air mixing chambers of variable shape or position**
46c-9/02 . having throttling valves, e.g. of piston shape, slidably arranged transversely to the passage
46c-9/04 . . with throttling valves sliding in a plane inclined to the passage
46c-9/06 . . with means for varying cross-sectional area of fuel spray nozzle dependent on throttle position
46c-9/08 . having throttling valves rotatably mounted in the passage
46c-9/10 . having valves, or like controls, of elastic-wall type for controlling the passage, or for varying cross-sectional area, of fuel-air mixing chambers
46c-9/12 . having other specific means for controlling the passage, or for varying cross-sectional area, of fuel-air mixing chambers
46c-9/14 . having venturi and nozzle relatively displaceable essentially along the venture axis

46c-11/00 Multi-stage carburettors; Register-type carburettors, i.e. with slidable or rotatable throttling valves in which a plurality of fuel nozzles, other than only an idling nozzle and a main one, are sequentially exposed to air stream by throttling valve
46c-11/02 . with throttling valve, e.g. of flap or butterfly type, in a later stage opening automatically
46c-11/04 . . the later-stage valves having damping means

46c-11/06 . Other carburettors with throttling valve of flap or butterfly type
46c-11/08 . Register carburettors with throttling valve movable transversally to air passage
46c-11/10 . Register carburettors with rotatable throttling valves

46c-13/00 Arrangements of two or more separate carburettors (re-atomising condensed fuel or homogenising fuel-air mixture 46c-29/00)**; Carburettors using more than one fuel** (apparatus for adding small quantities of secondary fuel 46c-25/00)
46c-13/02 . Separate carburettors
46c-13/04 . . structurally united
46c-13/06 . the carburettors using different fuels
46c-13/08 . Carburettors adapted to use liquid and gaseous fuels, e.g. alternatively

46c-15/00 Carburettors with heating, cooling, or thermal insulating means for combustion-air, fuel, or fuel-air mixture (heating, cooling, or thermally insulating float apparatus 46c-5/00; apparatus for thermally treating combustion-air, fuel, or fuel-air mixture, not being part of a carburettor, per se 46c-31/00)
46c-15/02 . with heating means, e.g. to combat ice-formation
46c-15/04 . . the means being electrical
46c-15/06 . Heat shielding, e.g. from engine radiations

46c-17/00 Carburettors having pertinent characteristics not provided for in, or of interest apart from, the apparatus of preceding main groups (apparatus for treating combustion-air, fuel, or fuel-air mixture by catalysts, electric means, magnetism, rays, sound waves, or the like 46c-27/00; combinations of carburettors and low-pressure fuel-injection apparatus 46c-71/00)
46c-17/02 . Floatless carburettors
46c-17/04 . . having fuel inlet valve controlled by diaphragm
46c-17/06 . . having overflow chamber determining constant fuel level
46c-17/08 . Carburettors having one or more fuel passages opening in a valve-seat surrounding combustion-air passage, the valve being opened by passing air
46c-17/10 . Carburettors having one or more fuel passages opening in valve-member of air throttle
46c-17/12 . . the valve-member being of butterfly type
46c-17/14 . Carburettors with fuel-supply parts opened and closed in synchronism with engine stroke
46c-17/16 . Carburettors having continuously-rotating bodies, e.g. surface carburettors (fuel injection by centrifugal forces 46c-69/06)
46c-17/18 . Other surface carburettors
46c-17/20 . . with fuel bath
46c-17/22 . . . with air bubbling through bath
46c-17/24 . . with wicks
46c-17/26 . . with other wetted bodies
46c-17/28 . . . fuel being drawn through a porous body
46c-17/30 . Carburettors with fire-protecting devices, e.g. combined with fire-extinguishing apparatus
46c-17/32 . . automatically closing fuel conduits on outbreak of fire
46c-17/34 . Other carburettors combined or associated with other apparatus, e.g. air filters (predominant aspects of the apparatus, see the relevant classes for such apparatus)
46c-17/36 . Carburettors having fitments facilitating their cleaning
46c-17/38 . Controlling of carburettors, not otherwise provided for (external control gear 46c-19/12)
46c-17/40 . Selection of particular materials for carburettors, e.g. sheet metal, plastic, or translucent materials
46c-17/42 . Float-controlled carburettors not otherwise provided for
46c-17/44 . Carburettors characterised by draught direction and not otherwise provided for
46c-17/46 . . with down-draught
46c-17/48 . . with up-draught

46c-17/50 . Carburettors having means for combating ice-formation (thermally 46c-15/02)
46c-17/52 . Use of cold, produced by carburettors, for other purposes (apparatus using the cold, see the relevant classes for such apparatus)

46c-19/00 Details, component parts, or accessories of carburettors, not provided for in, or of interest apart from, the apparatus of groups 46c-1/00 to 46c-17/00

46c-19/02 . Metering-orifices, e.g. variable in diameter (variable during operation 46c-7/18)
46c-19/04 . Fuel-metering pins or needles
46c-19/06 . Other details of fuel conduits
46c-19/08 . Venturis
46c-19/10 . . in multiple arrangement
46c-19/12 . External control gear, e.g. having dash-pots (dampening means in later stages of multi-stage carburettors 46c-11/04; carburettor control gear in which the carburettor aspects do not predominate, see the relevant classes)

46c-21/00 Apparatus for supplying engines with non-liquid fuels, e.g. gaseous fuels stored in liquid form

46c-21/02 . for gaseous fuels (apparatus for vaporising liquid fuel by heat 46c-31/00; engines with apparatus generating gas from solid fuel, e.g. from wood, 46a-43/08)
46c-21/04 . . Gas-air mixing apparatus (carburettors adapted to use liquid and gaseous fuels 46c-13/08; carburetting gases in general 24e)
46c-21/06 . . Apparatus for de-liquefying, e.g. by heating (discharging liquefied gases in general 17g)
46c-21/08 . for non-gaseous fuels (for engines operating on fuel containing oxidants 46a)
46c-21/10 . . for fuels with low melting point, e.g. apparatus having heating means
46c-21/12 . for fuels in pulverised state (engine plants with fuel-pulverising apparatus 46a)

Engine-pertinent apparatus for treating combustion-air, fuel, or fuel-air mixture, before their admission to engine, e.g. treating by adding substances

46c-23/00 Apparatus for adding secondary air to fuel-air mixture

46c-23/02 . with personal control, or with secondary-air valve controlled by main combustion-air throttle
46c-23/04 . with automatic control
46c-23/06 . . dependent on engine speed
46c-23/08 . . dependent on pressure in main combustion-air induction system
46c-23/10 . . dependent on temperature, e.g. engine temperature
46c-23/12 . characterised by being combined with device for, or by secondary air effecting, re-atomising of condensed fuel
46c-23/14 . characterised by adding hot air

46c-25/00 Engine-pertinent apparatus for adding non-fuel substances or small quantities of secondary fuel to combustion-air, main fuel, or fuel-air mixture (46c-43/00 takes precedence; adding secondary air to fuel-air mixture 46c-23/00)

46c-25/02 . adding water or steam
46c-25/04 . . the apparatus being combined or associated with combustion-air filter
46c-25/06 . adding lubricant vapours or exhaust gases
46c-25/08 . adding fuel vapours drawn from engine fuel reservoir
46c-25/10 . adding acetylene, non-waterborne hydrogen, non-airborne oxygen, or ozone
46c-25/12 . . the apparatus having means for generating such gases (using rays and simultaneously generating ozone 46c-27/06)
46c-25/14 . adding anti-knock agents, not provided for in groups 46c-25/02 to 46c-25/10

46c-27/00 Apparatus for treating combustion-air, fuel, or fuel-air mixture, by catalysts, electric means, magnetism, rays, sound waves, or the like

46c-27/02 . by catalysts
46c-27/04 . by electric means or magnetism
46c-27/06 . by rays
46c-27/08 . by sound or ultrasonic

46c-29/00	**Apparatus for re-atomising condensed fuel or homogenising fuel-air mixture** (combined with secondary-air supply 46c-23/12)
46c-29/02	. having rotary parts
46c-29/04	. having screens, gratings, baffles, or the like (rotary 46c-29/02)
46c-29/06	. . generating whirling motion of mixture
46c-29/08	. . having spirally-wound wires
46c-29/10	. . adjustable
46c-29/12	. having homogenising valves held open by mixture current
46c-29/14	. re-atomising or homogenising being effected by unevenness of internal surfaces of mixture intake
46c-31/00	**Apparatus for thermally treating combustion-air, fuel, or fuel-air mixture** (46c-21/06, 46c-21/10 take precedence; such apparatus being part of a carburettor or fuel-injection apparatus 46c-15/00, 46c-53/00; adding hot secondary air to fuel-air mixture 46c-23/14)
46c-31/02	. for heating
46c-31/04	. . combustion-air or fuel-air mixture (electrically 46c-31/12; by using heat from working cylinders or cylinder heads 46c-31/14)
46c-31/06	. . . by hot gases, e.g. by mixing cold and hot air
46c-31/08	. . . . the gases being exhaust gases
46c-31/10	. . . by hot liquids, e.g. lubricants
46c-31/12	. . electrically, e.g. for heating fuel
46c-31/14	. . by using heat from working cylinders or cylinder heads
46c-31/16	. . Other apparatus for heating fuel
46c-31/18	. . . to vaporise fuel
46c-31/20	. for cooling (cooling of charging-air or of scavenging-air 46a)
46c-33/00	**Other apparatus for treating combustion-air, fuel or fuel-air mixture**
46c-33/02	. for collecting and returning condensed fuel
46c-35/00	**Combustion-air cleaners, air intakes, intake silencers, or induction systems specially adapted for, or arranged on, internal-combustion engines** (air cleaners in general 50e)
46c-35/02	. Air cleaners
46c-35/04	. . specially arranged with respect to engine
46c-35/06	. . . combined or associated with engine's cooling blower or fan, or with flywheel
46c-35/08	. . with means for removing dust from cleaners
46c-35/10	. Air intakes; Induction systems (using kinetic or wave energy of charge in induction systems for improving quantity of charge 46a)
46c-35/12	. Intake silencers
46c-35/14	. Combined air cleaners and silencers
46c-35/16	. characterised by use in vehicles (predominant vehicle aspects, see the relevant classes for the vehicles)
46c-37/00	**Apparatus for feeding fuel from storage containers to carburettors or fuel-injection apparatus**
46c-37/02	. by means of suction apparatus, e.g. by air flow through carburettors (by driven pumps 46c-37/04)
46c-37/04	. by means of driven pumps (pump construction 27, 59)
46c-37/06	. . mechanically driven
46c-37/08	. . electrically driven
46c-37/10	. . . submerged in fuel, e.g. in reservoir
46c-37/12	. . fluid-driven, e.g. by compressed combustion-air
46c-37/14	. . the pumps being combined with other apparatus
46c-37/16	. . characterised by provision of personally-operated, e.g. manually-operated pumps
46c-37/18	. . characterised by provision of main and auxiliary pumps
46c-37/20	. characterised by means for preventing vapour lock

Fuel-injection apparatus (carrying the fuel into cylinders by high-pressure gas 46c-67/00; low-pressure fuel-injection 46c-69/00)

46c-39/00 Arrangements of fuel-injection apparatus with respect to engines; Pump drives adapted to such arrangements (arrangements of injectors 46c-61/14)

46c-39/02 . Arrangements of fuel-injection apparatus to facilitate the driving of pumps; Arrangements of fuel-injection pumps; Pump drives (46c-49/00 takes precedence)

46c-41/00 Fuel-injection apparatus with two or more injectors fed from a common pressure-source sequentially by means of a distributor

46c-41/02 . the distributor being spaced from pumping elements
46c-41/04 . . the distributor reciprocating
46c-41/06 . . the distributor rotating
46c-41/08 . the distributor and pumping elements being combined
46c-41/10 . . pump pistons acting as the distributor
46c-41/12 . . the pistons rotating to act as the distributor
46c-41/14 . . rotary distributor supporting pump pistons
46c-41/16 . characterised by the distributor being fed from a constant-pressure source, e.g. accumulator

46c-43/00 Fuel-injection apparatus operating simultaneously on two or more fuels or on a liquid fuel and another liquid, e.g. the other liquid being an anti-knock additive

46c-43/02 . Pumps peculiar thereto
46c-43/04 . Injectors peculiar thereto

46c-45/00 Fuel-injection apparatus characterised by having a cyclic delivery of specific time-pressure or time-quantity relationship (fuel injectors having such deliveries by means of valves furnished at seated ends with pintle- or plug-shaped extensions 46c-61/06)

46c-45/02 . with each cyclic delivery being separated into two or more parts
46c-45/04 . . with a small initial part
46c-45/06 . . . Pumps peculiar thereto
46c-45/08 . . . Injectors peculiar thereto
46c-45/10 . . Other injectors with multiple-part delivery, e.g. with vibrating valves
46c-45/12 . providing a continuous delivery with variable pressure

46c-47/00 Fuel-injection apparatus operated cyclically with fuel-injection valves actuated by fluid pressure (46c-49/00 takes precedence; apparatus with injection valves opened by fuel pressure and closed by non-fluid means, see the groups providing for other characteristics)

46c-47/02 . of accumulator-injector type, i.e. having fuel pressure of accumulator tending to open, and fuel pressure in other chamber tending to close, injection valves, and having means for periodically releasing that closing pressure
46c-47/04 . using fluid, other than fuel, for injection-valve actuation
46c-47/06 . Other fuel injectors peculiar thereto

46c-49/00 Fuel-injection apparatus in which injection pumps are driven, or injectors are actuated, by the pressure in engine working cylinders, or by impact of engine working piston

46c-49/02 . using the cylinder pressure, e.g. compression end pressure
46c-49/04 . using the piston impact

46c-51/00 Fuel-injection apparatus characterised by being operated electrically

46c-51/02 . specially for low-pressure fuel-injection (pumps per se 46c-51/04; injectors per se 46c-51/08)
46c-51/04 . Pumps peculiar thereto
46c-51/06 . Injectors peculiar thereto
46c-51/08 . . specially for low-pressure fuel-injection

46c-53/00	**Fuel-injection apparatus characterised by having heating, cooling, or thermally-insulating means**
46c-53/02	. with fuel-heating means, e.g. for vaporising
46c-53/04	. Injectors with heating, cooling, or thermally-insulating means
46c-53/06	. . with fuel-heating means, e.g. for vaporising
46c-53/08	. . with air cooling
46c-55/00	**Fuel-injection apparatus characterised by their fuel conduits or their venting means**
46c-55/02	. Conduits between injection pumps and injectors
46c-55/04	. Means for damping vibrations in injection-pump inlets
46c-57/00	**Fuel injectors combined or associated with other devices**
46c-57/02	. Injectors structurally combined with fuel-injection pumps
46c-57/04	. the devices being combustion-air intake or exhaust valves
46c-57/06	. the devices being sparking-plugs
46c-59/00	**Pumps specially adapted for fuel-injection and not provided for in groups 46c-39/00 to 46c-57/00** (general features of pumps 59)
46c-59/02	. of reciprocating-piston type
46c-59/04	. . characterised by special arrangement of cylinders with respect to piston-driving shaft, e.g. arranged parallel to that shaft
46c-59/06	. . . with cylinders arranged radially to driving shaft, e.g. in V-arrangement or star-arrangement
46c-59/08	. . characterised by two or more pumping elements with conjoint outlet
46c-59/10	. . characterised by the piston drive
46c-59/12	. having other positive-displacement pumping elements, e.g. rotary
46c-59/14	. . of elastic-wall type
46c-59/16	. characterised by having multi-stage compression of fuel
46c-59/18	. characterised by the pumping action being achieved through release of pre-compressed springs
46c-59/20	. Varying fuel delivery in quantity or timing
46c-59/22	. . Varying quantity by adjusting cylinder-head space
46c-59/24	. . with constant-length-stroke pistons having variable effective portion of stroke
46c-59/26	. . . caused by movements of pistons relative to their cylinders
46c-59/28	. . . . Mechanisms therefor
46c-59/30	. . with variable-length-stroke pistons
46c-59/32	. . fuel delivery being controlled by means of fuel-displaced auxiliary pistons, which effect injection
46c-59/34	. . by throttling of passages to pumping elements or of overflow passages
46c-59/36	. . by variably-timed valves controlling fuel passages
46c-59/38	. Pumps characterised by adaptations to special uses or conditions
46c-59/40	. . for reversible engines
46c-59/42	. . for starting of engines
46c-59/44	. Details, component parts, or accessories not provided for in, or of interest apart from, the apparatus of groups 46c-59/02 to 46c-59/42
46c-59/46	. . Valves (in general 47g1)
46c-59/48	. . Assembling; Disassembling; Replacing
46c-61/00	**Fuel injectors not provided for in groups 46c-39/00 to 46c-57/00**
46c-61/02	. of valve-less type
46c-61/04	. having valves (valves in general 47g1)
46c-61/06	. . the valves being furnished at seated ends with pintle- or plug-shaped extensions
46c-61/08	. . the valves opening in direction of fuel flow
46c-61/10	. . Other injectors with elongated valve bodies, i.e. of needle-valve type
46c-61/12	. . . characterised by the provision of guiding or centring means for valve bodies
46c-61/14	. Arrangements of injectors with respect to engines; Mounting of injectors
46c-61/16	. Details not provided for in, or of interest apart from, the apparatus of groups 46c-61/02 to 46c-61/14
46c-61/18	. . Injection nozzles, e.g. having valve-seats
46c-61/20	. . Closing valves mechanically, e.g. arrangements of springs or weights

46c-63/00 **Other fuel-injection apparatus having pertinent characteristics not provided for in groups 46c-39/00 to 46c-57/00; Details, component parts, or accessories of fuel-injection apparatus, not provided for in, or of interest apart from, the apparatus of groups 46c-39/00 to 46c-61/00**

46c-63/02 . Fuel-injection apparatus having several injectors fed by a common pumping element, or having several pumping elements feeding a common injector; Fuel-injection apparatus having provisions for cutting-out pumps, pumping elements, or injectors; Fuel-injection apparatus having provisions for variably interconnecting pumping elements and injectors alternatively

46c-63/04 . Fuel-injection apparatus having injection valves held closed by a cyclically-operated mechanism for a time and automatically opened by fuel pressure, e.g. of constant-pressure pump or accumulator, when that mechanism releases the valve

46c-63/06 . Use of pressure wave generated by fuel inertia to open injection valves

46c-65/00 **Testing fuel-injection apparatus**

Fuel-injection by high-pressure gas carrying the fuel into engine working cylinders; Low-pressure fuel-injection

46c-67/00 **Apparatus in which fuel-injection is effected by means of high-pressure gas, the gas carrying the fuel into working cylinders of the engine, e.g. air-injection type** (using compressed air for low-pressure fuel-injection apparatus 46c-69/08)

46c-67/02 . the gas being compressed air, e.g. compressed in pumps (arrangements or adaptations of such pumps 46a)

46c-67/04 . . the air being extracted from working cylinders of the engine

46c-67/06 . the gas being other than air, e.g. steam, combustion gas

46c-67/08 . . the gas being generated by combustion of part of fuel other than in engine working cylinders

46c-67/10 . Injectors peculiar thereto, e.g. of valveless type

46c-67/12 . . having valves

46c-67/14 . characterised by provisions for injecting different fuels, e.g. main fuel and readily self-igniting starting-fuel

46c-69/00 **Low-pressure fuel-injection apparatus** (electrically-operated 46c-51/00)

46c-69/02 . Pumps peculiar thereto

46c-69/04 . Injectors peculiar thereto

46c-69/06 . characterised by the pressurisation of the fuel being caused by centrifugal force acting on the fuel

46c-69/08 . characterised by the fuel being carried by compressed air into main stream of combustion-air

46c-69/10 . peculiar to scavenged two-stroke engines, e.g. injecting into crankcase-pump chamber

46c-71/00 **Combinations of carburettors and low-pressure fuel-injection apparatus** (means for enriching charge on sudden air throttle opening of carburettors 46c-7/06)

46c-71/02 . with fuel-air mixture being produced by the carburettor and being compressed by a pump for subsequent injection into main combustion-air (adaptations or arrangements of such pumps 46a)

46c-71/04 . with carburettor being used at starting or idling only and injection apparatus being used during normal operation of engine

46d Hot-gas piston engines, compressed-air piston engines, thermal piston engines with external combustion; recovery of waste heat and exhaust gases of thermal piston engines

Hot-gas [hot air] piston engines with external heating (gas engines 46a1)

46d-1 Open-cycle hot-gas piston engines (open hot-gas turbines 46f-3/10)

46d-2 Closed-cycle hot-gas piston engines (closed hot-gas turbines 46f-3/30)

46d-3 Design and arrangement of auxiliary apparatus for hot-gas piston engines

Compressed-air piston engines

46d-5/01	Compressed-air piston engines in general, also where steam may replace compressed air (for rotary piston engines 14b)
46d-5/02	Engines for vibrating chutes, as far as the structure of engine is concerned
46d-5/03	Compressed-air piston engines for tools having a rotary or percussion motion (compressed-air turbines for tools 14c-23/01, pneumatic hand tools for general use 87b-2/01 – 87b-2/20)
46d-5/04	Compressed-air piston engines for vehicles (63c-2; compressed-air turbines for vehicles 14c-23/01)
46d-5/05	Compressed-air engines with rotary piston, oscillating vane-pistons, etc. (insofar as steam may replace compressed air 14b)
46d-5/06	Storage of compressed air for compressed-air piston engines with means for production and bleed of compressed air, insofar as they are operationally directly connected with storage (in general 27b, 1502)
46d-5/07	Treatment of compressed air before its use in compressed-air piston engines, e.g. drying, heating, enriching with lubricants, etc. (in general 27b-15/02)
46d-5/08	Vacuum and atmospheric piston engines (vacuum turbines 14c-23/02)

Thermal piston engines with external combustion

46d-6	Thermal piston engines in which the propellant gas is produced in a generator separated from the power cylinder; propellant-gas generators (fuel-gas producers 24e; 26a; free-piston engines as propellant-gas producers 46a4-7; 46f-7/01)
46d-7	Gas-steam piston engines and propellant-gas producers as single units; propellant gas and steam introduced into engine mixed or separately
46d-9	Gas-compressed-air piston engines and propellant gas-producers as single units; propellant gas and compressed-air introduced into engine mixed or separately
46d-10	Gas-compressed-air steam piston engines and propellant-gas producers as single units; propellant gas, compressed air, and steam introduced into engine mixed or separately

Recovery of waste heat and exhaust gases of thermal piston engines (of internal-combustion turbines 46f-5; in producer-gas operation 46e2-120)

46d-14/01	Exhaust-gas piston engines (compound internal-combustion piston engines 46a1-11, 46a1-24; 46a2-11, 46a2-24, 46a2-55, 46a2-69)
46d-14/02	Recovery of waste heat of thermal piston engines, e.g. for steam generation (structure of waste-heat recovery boilers 13a, 13g)
46d-15	Storage of thermal energy in thermal piston engines
46d-16	Locomobiles with gas generators, in general
46d-17	Recovery of exhaust gases as such; generation of gases poor in oxygen in thermal piston engines; recovery of chemicals from thermal piston engines

46d	**(IPC: F02G) Hot gas or combustion-product engine plants** (steam engine plants, special vapour plants, plants operating on either hot gas or combustion-product gases together with other fluid 14h; gas-turbine plants 46f; jet-propulsion plants 46g)**; Use of waste heat of combustion engines, not otherwise provided for**
46d-1/00	**Hot gas engine plants, e.g. hot-air piston-engine plants** (combustion-product engine plants 46d-3/00)
46d-1/02	. of open-cycle type
46d-1/04	. of closed-cycle type
46d-1/06	. Controlling
46d-3/00	**Plants characterised by the engines being supplied with combustion-product gases** (46d-1/00 takes precedence)
46d-3/02	. with reciprocating-piston engines

46d-5/00	**Profiting from waste heat of combustion engines, not otherwise provided for**
46d-5/02	. Profiting from waste heat of exhaust gases
46d-5/04	. . in combination with other waste heat from combustion engines
46e	**Spring-actuated and gravity-actuated engines; engines for the use of the heat of the earth, water, air, or sun for power; gins** (clocks 43a, buoyancy-actuated engines 88b)
46e-1	Spring-actuated engines with coil springs
46e-2	Spring-actuated engines with helical springs under tension or compression
46e-3	Spring-actuated engines with springs under torsion
46e-4	Gravity-actuated engines
46e-5	Hand and foot actuated motors; gins, treadle gins with accessories (45d-5)
46e-6	Miscellaneous prime movers not mentioned elsewhere, in general
46e-7	Structural features
46e-8	Means for power transmission (47h-20)
46e-9	Use of solar heat, particularly for the production of power
46e-10	Use of the heat of the earth, water, and air, of changes in temperature, or of changes in volume of gaseous, liquid, and solid bodies for the production of power
46f	**Internal-combustion turbines: gas and oil turbines** (steam and air turbines 14c; hydraulic turbines 88a)
	Pressure and impulse turbines
46f-1	Explosion turbines with closed combustion chambers: turbines with constant volume combustion
46f-2	Explosion turbines with open combustion chambers
46f-2/50	Explosion turbines with rotary combustion chambers
	Turbines with constant pressure combustion
46f-3	Turbines with constant pressure combustion
46f-3/01	in general, including working processes
46f-3/10	open cycle
46f-3/20	simultaneous open and closed, as well as partly closed cycle
46f-3/30	closed cycle
46f-3/40	Turbines combined with fuel source: with fuel-gas generators, operation with pressure-type carburettors, natural gas, blast furnace gas, etc. (gas generators 24e; fuel-gas production 26a)
	Other turbines
46f-3/50	Friction turbines, scroll turbines
46f-3/60	Reaction turbines
46f-3/70	Gas steam turbines
46f-3/80	Turbines with direct introduction and combustion of solid fuels
	Cooling
46f-4/01	Cooling by means of liquid, steam
46f-4/02	Cooling by means of air, gas
	Recovery of waste heat and exhaust gases
46f-5/01	Exhaust gas turbines, in general and forming with blower a single structural unit (blower drive 27c, 46a9, 46c1)
46f-5/02	Recovery of waste heat from, and in, internal-combustion turbines
46f-5/03	Means for conveying exhaust gases from source [thermal piston engine] to exhaust turbine

Operation with auxiliary fluid

46f-6/01 Auxiliary fluid having oscillating motion
46f-6/02 Auxiliary fluid having circulating motion

Generation and heating of propellant gases for internal combustion turbines (gas producers 24e; fuel-gas production 26a; heat exchangers 17e, 17f)

46f-7/01 Piston engines with combustion inside the cylinder
46f-7/02 Piston engines with combustion in separate combustion chamber
46f-7/03 Constant-pressure combustion chambers with internal as well as with internal and external heating of propellant gases
46f-7/06 Gas heaters with external combustion

Details of internal-combustion turbines

46f-8/01 Control and regulation in general
46f-8/02 Control by rotor
46f-8/03 Blades for rotors of internal-combustion turbines (steam turbine blades 14c-11; production of turbine blades 49l-7)
46f-8/04 Compression, pressure exchangers for internal-combustion turbines
46f-9 Bearings, lubrication, packings
46f-10 Rotors
46f-11 Connections between engine parts, mechanical and thermal stress equalisation, heat insulation
46f-12 Arrangement and drive of auxiliary and driven engines and accessories
46f-13 Starting and ignition
46f-14 Fuel supply and atomisation
46f-15 Miscellaneous

46f **(IPC: F02C) Gas-turbine plants** (construction of turbines 14c; construction of compressors or fans 27; fuel combustion apparatus in general 24; gas-turbine plant working on a refrigerating cycle 17; using gas-turbine plants in vehicles, see the relevant vehicle classes)

Note:
This subclass comprises:
(a) combustion product or hot gas turbine plants (steam turbine plants 14h);
(b) internal combustion turbines or turbine plants;
(c) turbine plants in which the working fluid is an unheated, pressurised gas (special vapour plants 14h).

46f-1/00 **Gas-turbine plants characterised by the working fluid** (the fluid being combustion products 46f-3/00)
46f-1/02 . the fluid being unheated
46f-1/04 . the fluid being heated indirectly
46f-1/06 . . the heating being effected by reheated exhaust gas

46f-3/00 **Gas-turbine plants characterised by the working fluid being generated by combustion** (by intermittent combustion 46f-5/00)
46f-3/02 . using exhaust-gas pressure in a pressure exchanger to compress combustion-air
46f-3/04 . having a turbine driving a compressor
46f-3/06 . . the compressor being of the axial-flow type
46f-3/08 . . the compressor being of the centrifugal or radial flow type
46f-3/10 . . with another turbine driving output shaft but not driving the compressor
46f-3/12 . . with means for storing compressed air
46f-3/14 . the combustion chambers being associated with the turbine or compressor
46f-3/16 . . the combustion chambers being formed at least partly in the turbine rotor
46f-3/18 . using heaters between turbine stages

46f-3/20	. the fluid being generated by combustion of a specific fuel (regulating fuel supply 46f-9/00)
46f-3/22	. . the fuel being gaseous
46f-3/24	. . the fuel being liquid
46f-3/26	. . the fuel being pulverulent or solid
46f-5/00	**Gas-turbine plants characterised by the working fluid being generated by intermittent combustion**
46f-5/02	. the combustion chambers being associated with the turbine or compressor
46f-5/04	. . the chambers being formed at least partly in the turbine rotor
46f-5/06	. the fluid being generated in combustion apparatus of the positive-displacement type having essentially no mechanical power output (internal-combustion engines of the positive-displacement type with prolonged expansion in exhaust turbines 46a)
46f-5/08	. . the apparatus being of the free-piston gas-generator
46f-5/10	. the fluid forming an oscillating gas column, i.e. the combustion chambers having no valves, e.g. using Helmholtz effect
46f-5/12	. the combustion chambers having inlet or outlet valves, e.g. Holzwarth gas-turbine plants
46f-7/00	**Other gas-turbine plants; Component parts, details or accessories, not provided for in, or of interest apart from, groups 46f-1/00 to 46f-5/00** (controlling 46f-9/00)
46f-7/02	. Plants having two or more turbines and not otherwise provided for; Adaptations of plants for special use; Combinations of plants with other devices (aspects predominantly concerning such devices, see the relevant classes for such devices)
46f-7/04	. Air intakes
46f-7/06	. Arrangements of bearings; Lubricating
46f-7/08	. Heating air supply before combustion, e.g. by exhaust gases
46f-7/10	. . by means of regenerative heat-exchangers
46f-7/12	. Cooling of plants
46f-7/14	. . Cooling of fluids in the plants
46f-7/16	. . characterised by cooling medium
46f-7/18	. . . the medium being gaseous, e.g. air
46f-7/20	. Mounting or supporting of plant; Accommodating heat expansion or creep
46f-7/22	. Fuel supply systems
46f-7/24	. Heat or noise insulation
46f-7/26	. Starting; Ignition
46f-7/28	. Arrangement of seals
46f-7/30	. Preventing corrosion in gas-swept spaces
46f-7/32	. Arrangement of auxiliaries
46f-7/34	. Using waste heat externally of the plant (using exhaust products for propulsion 46g)
46f-9/00	**Controlling gas-turbine plants** (controlling turbines in general 14c; controlling or regulating in general 42r)
46f-9/02	. Regulating, i.e. controlling automatically
46f-9/04	. . fuel supply
46f-9/06	. . . by varying fuel-pump output
46f-9/08	. . . by throttling
46f-9/10	. . . by returning fuel from fuel-pump output to fuel-pump inlet
46f-9/12	. . . . by returning fuel from burners
46f-9/14	. . air supply (heating air supply before combustion 46f-7/08)

46g **Mobile combustion reaction engines and fuels therefor** (internal-combustion reaction turbines 46f-3/60; steam reaction turbines 14c-2; water jet turbines 88a-2; arrangements and installation in aircraft 62b-37, in motor vehicles 63e-29/05) in ships 65f1-6/30; in rocket missiles 72d-19/01; signal rockets 74d-7; pyrotechnical rockets 78d-1/01)

Rocket propulsion

46g-1	Generation of propelling gases in a combustion chamber

46g-1/01	for solid fuels, arrangement and form of fuels
46g-1/05	for liquid fuels or gases
	Jet engines and ram jet propulsion
46g-2	Generation of propelling gases in a piston engine
46g-2/01	Jet engines with piston engine operation
46g-2/03	Jet engines with turbine operation
46g-2/06	Ram jet propulsion
46g-3	Details: compression, cooling, fuel feeding, propellants, etc.
	Reaction devices (muffling, flame damping 46c6; hot air generation for aeroplanes 62c-15/01)
46g-4/01	Use of exhaust gases from internal-combustion engines
46g-4/05	Use of compressed gas produced in piston engines
46g-5	Combustion reaction engines with auxiliary fluid
	Cooling
46g-7/01	by means of liquids or steam
46g-7/05	by means of air or gas
	Regulation
46g-8/06	of combustion chamber
46g-8/10	of reaction nozzle
	Miscellaneous
46g-10	Nozzle forms
46g-16	Structural details
46g-20	Fuels for reaction propulsion engines, e.g. for propulsion of rockets or jet engines according to chemical composition (fuels for internal-combustion engines 46a6-7; fuel gases 26a, 24e; fuel oils 23b-4/02; solid fuels 10b)

46g	**(IPC: F02K) Jet-propulsion plants** (arrangement or mounting of jet-propulsion plants in land vehicles or vehicles in general 63; controlling aircraft, flight direction, or attitude by jet reaction 62a2, 62a3; plants characterised by the power of the working fluid being divided between jet propulsion and another form of propulsion, e.g. propeller, 46a, 46f; features of jet-propulsion plants common to gas-turbine plant 46f)
46g-1/00	**Plants characterised by the form or arrangement of a jet pipe or nozzle; Pipes or nozzles peculiar thereto**
46g-1/02	. Augmenting mass flow by introduction of ambient air
46g-1/04	. Mounting of an exhaust cone in the jet pipe
46g-1/06	. Varying effective area of jet pipe or nozzle
46g-1/08	. . by axially moving a conical-shaped or other internal member
46g-1/10	. . by distorting the jet pipe or nozzle
46g-1/12	. . by means of pivoted flaps
46g-1/14	. . by means of fluid jets
46g-1/16	. . conjointly with another control
46g-1/18	. . characterised by automatic variation
46g-1/20	. Deflecting part of fluid stream from propulsive nozzles
46g-1/22	. Other constructions of jet pipes
46g-1/24	. Other constructions of nozzles
46g-1/26	. . for noise of flame suppression (characterised by the power of the working-fluid being divided between jet-propulsion and another form of propulsion, e.g. propeller, 46a, 46f)
46g-3/00	**Plants including a gas turbine driving a compressor or a ducted fan**
46g-3/02	. in which part of the working fluid by-passes the turbine and combustion chamber

46g-3/04	. . the plant including ducted fans, i.e. fans with high volume, low-pressure outputs, for augmenting jet thrust
46g-3/06	. . . the fan being connected to the compressor
46g-3/08	. with preheat of the working-fluid; Control thereof
46g-3/10	. . by after-burners
46g-3/12	. characterised by having more than one gas turbine
46g-5/00	**Plants including an engine, other than a gas turbine, driving a compressor or a ducted fan**
46g-5/02	. the engine being of the reciprocating-piston type
46g-7/00	**Plants in which the working-fluid is used in a jet only, i.e. the plants not having a turbine or other engine driving a compressor or a ducted fan; Control thereof** (rockets 46g-9/00)
46g-7/02	. the jet being intermittent, i.e. pulse jet
46g-7/04	. . with resonant combustion chambers
46g-7/06	. . with combustion chambers having valves
46g-7/08	. the jet being continuous
46g-7/10	. characterised by having ram-action compression, i.e. aero-thermo-dynamic-ducts or athodyds
46g-9/00	**Rockets, i.e. plants carrying both fuel and oxidant therefor; Control thereof** (fireworks, chemical composition of propellants 78d)
46g-9/02	. the fuel being liquid or gaseous
46g-9/04	. the fuel being solid
46g-9/06	. Combinations, e.g. of multiple-stage type
46g-11/00	**Other plants; Other details of plants; Other plant control**
46g-11/02	. Cooling not otherwise provided for, or of interest apart from, groups 46g-1/00 to 46g-9/00
46g-11/04	. . by gases
46h	**Heating and thermal power installations combined with piston engines and/or turbines and/or jet engines for general use** (for land vehicles 20b, 63c; for aircraft 62b, 62c; for marine craft 65f1; for steam power installations 14h)
46h	(No subdivision)
46i	**(IPC: F02F) Cylinders, pistons, casings or crankcase ventilation for combustion engines; Arrangements of sealings in combustion engines** (specially adapted for rotary-piston or oscillating-piston internal-combustion engines 46a; specially adapted for gas-turbine plants 46f; specially adapted for jet-propulsion plants 46g)
	Note: **In considering the relationship between class 47 and subclass 46i, class 47 will take precedence unless the subject-matter is specific to combustion engines.**
46i-1/00	**Cylinders; Cylinder heads** (in general 47f2)
46i-1/02	. having cooling means (cylinder heads 46i-1/26)
46i-1/04	. . for air cooling
46i-1/06	. . . Shape or arrangement of cooling fins; Finned cylinders
46i-1/08	. . . . running-liner and cooling-part of cylinder being different parts or of different material
46i-1/10	. . for liquid cooling
46i-1/12	. . . Preventing corrosion of liquid-swept surfaces
46i-1/14	. . . Cylinders with means for directing, guiding, or distributing liquid stream
46i-1/16	. . . Cylinder liners of wet type
46i-1/18	. Other cylinders
46i-1/20	. . characterised by constructional features providing for lubrication

46i-1/22 . . characterised by having ports in cylinder wall for scavenging or charging
46i-1/24 . Cylinder heads
46i-1/26 . . having cooling means
46i-1/28 . . . for air cooling
46i-1/30 . . . . Finned cylinder heads
46i-1/32 . . . . . the cylinder heads being of overhead-valve type
46i-1/34 . . . . . with means for directing or distributing cooling medium (46i-1/32 takes precedence)
46i-1/36 . . . for liquid cooling
46i-1/38 . . . . the cylinder heads being of overhead-valve type
46i-1/40 . . . . Cylinder heads with means for directing, guiding, or distributing liquid stream (46i-1/38 takes precedence)
46i-1/42 . . Shape or arrangement of intake or exhaust channels in cylinder heads

46i-3/00 Pistons
46i-3/02 . having means for accommodating or controlling heat expansion
46i-3/04 . . having expansion-controlling inserts
46i-3/06 . . . the inserts having bimetallic effect
46i-3/08 . . . the inserts being ring-shaped
46i-3/10 . having surface coverings (46i-3/02 takes precedence)
46i-3/12 . . on piston heads
46i-3/14 . . . within combustion chambers
46i-3/16 . having cooling means
46i-3/18 . . the means being a liquid or solid coolant, e.g. sodium, in a closed chamber in piston
46i-3/20 . . the means being a fluid flowing through or along piston
46i-3/22 . . . the fluid being liquid
46i-3/24 . having means for guiding gases in cylinders, e.g. for guiding scavenging charge in two-stroke engines
46i-3/26 . having combustion chamber in piston head (the surface thereof being covered 46i-3/14)
46i-3/28 . Other pistons with specially-shaped head

46i-5/00 Piston rings, e.g. associated with piston crown

46i-7/00 Casings, e.g. crankcases (engine casings in general 47a2)

46i-9/00 Crankcase ventilating or breathing
46i-9/02 . by means of additional source of positive or negative pressure
46i-9/04 . having means for purifying air before leaving crankcase, e.g. removing oil
46i-9/06 . specially adapted for submersible engines, e.g. of armoured cars

46i-11/00 Arrangements of sealings in combustion engines (piston rings 46i-5/00; sealings per se 47f2)

46k (IPC: F02P) Ignition, other than compression ignition, for internal-combustion engines (specially adapted for rotary-piston or oscillating-piston engines 46a-53/12)

Electric spark ignition installations characterised by the type of ignition power generation or storage

46k-1/00 Installations having electric ignition energy generated by magneto- or dynamo-electric generators without subsequent storage
46k-1/02 . the generator rotor being characterised by forming part of the engine flywheel
46k-1/04 . the generator being specially adapted for use with specific engine types, e.g. engines with V-arrangement of cylinders
46k-1/06 . Generator drives, e.g. having snap couplings
46k-1/08 . Layout of circuits

46k-3/00 Other installations
46k-3/02 . having inductive energy storage, e.g. arrangements of induction coils
46k-3/04 . . Layout of circuits

46k-3/06 . having capacitive energy storage (piezo-electric or electrostatic ignition 46k-3/12)
46k-3/08 . . Layout of circuits (for low tension 46k-3/10)
46k-3/10 . . Low-tension installation, e.g. using surface-discharge sparking plugs
46k-3/12 . Piezo-electric ignition; Electrostatic ignition

Advancing or retarding electric ignition spark; Arrangements of distributors or of circuit-makers or -breakers for electric spark ignition; Electric spark ignition control or safety means, not otherwise provided for

46k-5/00 Advancing or retarding ignition
46k-5/02 . non-automatically; dependent on position of personal controls of engine, e.g. throttle position
46k-5/04 . automatically (dependent on position of personal control of engine 46k-5/02)
46k-5/06 . . dependent on engine speed, e.g. by mechanical means only (dependent on fluid pressure in engine 46k-5/10)
46k-5/08 . . . by electrical means
46k-5/10 . . dependent on fluid pressure in engine, e.g. combustion-air pressure
46k-5/12 . . . dependent on a specific pressure other than that of combustion-air, e.g. of exhaust, cooling fluid, lubricant
46k-5/14 . . dependent on specific conditions other than engine speed or engine fluid pressure, e.g. temperature
46k-5/16 . characterised by the transmission between sensing elements or personal controls and final actuating elements

46k-7/00 Arrangements of distributors or of circuit-makers or -breakers, e.g. of distributor and circuit-breaker combinations (advancing or retarding ignition 46k-5/00; constructions of such devices per se 46k-27/01 – 46k-27/03)
46k-7/02 . of distributors
46k-7/04 . . having air-tight casings
46k-7/06 . of circuit-makers or circuit-breakers, e.g. of contact-breakers
46k-7/08 . . having air-tight casings
46k-7/10 . Drives of distributors or of circuit-makers or circuit-breakers

46k-9/00 Electric spark ignition control, not otherwise provided for

46k-11/00 Safety means for electric spark ignition, not otherwise provided for
46k-11/02 . Preventing damage to engines or engine-driven gearing
46k-11/04 . Preventing unauthorised use of engines (of vehicles 63c)
46k-11/06 . Indicating unsafe conditions

46k-13/00 Sparking plugs structurally combined with other parts of internal-combustion engines (predominant aspects of the parts, see the relevant subclasses for the parts)
46k-13/02 . combined with fuel-supply devices

46k-15/00 Electric spark ignition having characteristics not provided for in, or of interest apart from, groups 46k-1/00 to 46k-13/00
46k-15/02 . Arrangements having two or more sparking plugs
46k-15/04 . one of the spark electrodes being mounted on the engine working piston
46k-15/06 . the electric spark triggered by engine working cylinder compression
46k-15/08 . having multiple-spark ignition, i.e. ignition occurring simultaneously at different places in one engine cylinder or in two or more separate engine cylinders
46k-15/10 . having continuous electric sparks
46k-15/12 . having means for strengthening spark during starting

46k-17/00 Testing, e.g. in combination with adjusting, of ignition installations, e.g. of timing (testing of sparking plugs 46k-53, 46k-54)**; Testing of ignition timing in compression-ignition engines**

Other ignition

46k-19/00 Incandescent ignition, e.g. during starting of internal-combustion engines

46k-19/02 . electric, e.g. layout of circuits of apparatus having glowing plugs
46k-19/04 . non-electric, e.g. heating incandescent spots by burners (use of burners for direct ignition 46k-21/00)

46k-21/00 Direct use of flames or burners for ignition

46k-21/02 . the flames being kept burning essentially external to engine working chambers
46k-21/04 . Burning-cartridges or like inserts being arranged in engine working chambers (as starting aid 46l-17/02)

46k-23/00 Other ignition

46k-23/02 . Friction, pyrophoric, or catalytic ignition
46k-23/04 . Other physical ignition means, e.g. using laser rays

Ignition generators

46k-25/01 for engines with cylinder arranged in "V"
46k-25/02 combined with illumination generator
46k-25/03 with flywheel magnets
46k-25/04 dynamoelectric
46k-25/05 with rotary conductors for magnetic lines of force
46k-25/06 with special magnets, e.g. bell magnets
46k-25/07 with multi-pole magnets
46k-25/08 with special pole-shoe shapes
46k-25/09 Make-and-break ignition
46k-25/10 Miscellaneous electromagnetic ignition generators
46k-25/11 Components: armatures, insulators, collectors, etc.
46k-26 Ignition arrangements with radiation protection (21a4-22)
46k-27/01 Distribution and contact breakers, combined
46k-27/02 Contact breakers per se
46k-27/03 Distributors per se
46k-29 Vibrators, coils; electrical details or accessories not otherwise provided for

46k-33/00 (IPC: H01T 13/00) Sparking plugs

46k-33/02 . Details
46k-33/04 . . Means providing electrical connection to sparking plug
46k-33/06 . . Covers forming a part of the plug and protecting it against adverse environment
46k-33/08 . . Mounting, fixing, or sealing of sparking plugs, e.g. in combustion chamber
46k-33/10 . . . by bayonet-type connection
46k-33/12 . . Means on sparking plugs for facilitating engagement by tool or by hand
46k-33/14 . . Means for self-cleaning
46k-33/16 . . Means for dissipating heat
46k-33/18 . . Means for heating, e.g. for drying
46k-33/20 . characterised by features of the electrodes or insulation
46k-33/22 . . having two or more electrodes embedded in insulation (for two or more sparks 46k-33/46)
46k-33/24 . . having movable electrodes (46k-33/28 takes precedence)
46k-33/26 . . . for adjusting spark gap otherwise than by bending of electrode
46k-33/28 . . having spherically shaped electrodes, e.g. ball-shaped
46k-33/30 . . . mounted so as to permit free movement
46k-33/32 . . characterised by features of the earthed electrode
46k-33/34 . . characterised by the mounting of electrodes in insulation, e.g. by embedding
46k-33/36 . . characterised by the joint between insulation and body, e.g. using cement
46k-33/38 . . Selection of materials for insulation
46k-33/40 . structurally combined with other devices, e.g. for preventing unauthorised use
46k-33/42 . . with magnetic spark generators
46k-33/44 . . with transformers, e.g. for high-frequency ignition

46k-33/46	. having two or more spark gaps
46k-33/48	. having means for rendering sparks visible
46k-33/50	. having means for ionisation of gap
46k-33/52	. characterised by a discharge along a surface
46k-33/54	. having electrodes arranged in a partly-enclosed ignition chamber
46k-33/56	. characterised by having component parts which are easily assembled or disassembled
46k-35	Leads for sparkplugs (electrical connectors as parts or accessories of spark plugs 46k-33/04)
46k-36	Protective covers for spark plugs (as part of spark plugs 46k-33/06); plug holders
46k-37	Plug wrenches, combination wrenches (87c)
46k-42	Spark plug cleaners
46k-50	Series sparks in plug lead
46k-53	Testing of spark plugs
46k-54	Testing of spark plugs with vacuum or inert gas tubes
46k-59	Glow plugs
46k-63	Manufacture and maintenance of spark plugs, not otherwise provided for

46l **(IPC: F02N) Starting of combustion engines** (starting of free-piston combustion-engines 46a-71/02; starting of gas-turbine plants 46f-7/26)**; Starting aids for such engines, not otherwise provided for**

Note:
The starting of engines which are not explicitly stated to be combustion engines classified in this subclass in so far as their starting is equivalent to that of combustion engines.

Muscle-operated starting apparatus (with intermediate power storage 46l-5/00 to 46l-15/00)

46l-1/00	**Starting apparatus having hand cranks**
46l-1/02	. having safety means preventing damage caused by reverse rotation
46l-3/00	**Other muscle-operated starting apparatus**
46l-3/02	. having pull-cords
46l-3/04	. having foot-actuated levers

Power-operated starting apparatus; Muscle-operated starting apparatus with intermediate power storage

46l-5/00	**Starting apparatus having mechanical power storage**
46l-5/02	. of spring type
46l-5/04	. of inertia type
46l-7/00	**Starting apparatus having fluid-driven auxiliary engines or apparatus**
46l-7/02	. the apparatus being of single-stroke piston type, e.g. pistons acting on racks or pull-cords
46l-7/04	. . the pistons acting on screw-threaded members to effect rotation
46l-7/06	. the engines being of reciprocating-piston type (of internal-combustion type 46l-7/10)
46l-7/08	. the engines being of rotary type
46l-7/10	. characterised by using auxiliary engines or apparatus of combustion type (by using explosive cartridges 46l-13/00)
46l-7/12	. . the engines being of rotary type, e.g. turbines (46l-7/14 takes precedence)
46l-7/14	. . the starting engines being readily removable from main engines, e.g. of portable type
46l-9/00	**Starting of engines by supplying auxiliary pressure fluid to their working chambers**
46l-9/02	. the pressure fluid being generated directly by combustion (by using explosive cartridges 46l-13/00)
46l-9/04	. the pressure fluid being generated otherwise, e.g. by compressing air

46l-11/00	**Starting of engines by means of electric motors** (electric motors per se 46l-19/00)
46l-11/02	. the motors having longitudinally-shiftable rotors
46l-11/04	. the motors being associated with current generators
46l-11/06	. . and with ignition apparatus
46l-11/08	. Circuits specially adapted for starting of engines
46l-11/10	. Safety devices (46l-11/08 takes precedence)
46l-11/12	. Starting of engines by means of mobile, e.g. portable, starting sets
46l-11/14	. Starting of engines by means of electric starters with external current supply (46l-11/12 takes precedence)
46l-13/00	**Starting of engines, or driving of starting apparatus by use of explosives, e.g. stored in cartridges**
46l-13/02	. Cartridges specially adapted therefor (gas cartridges in general 78e)
46l-15/00	**Other power-operated starting apparatus; Component parts, details, or accessories, not provided for in, or of interest apart from, groups 46l-5/00 to 46l-13/00**
46l-15/02	. Gearing between starting engines and started engines; Engagement or disengagement thereof
46l-15/04	. . the gearing including disengaging toothed gears
46l-15/06	. . . the toothed gears being moved by axial displacement
46l-15/08	. . the gearing being of friction type
46l-15/10	. Safety devices not otherwise provided for
46l-17/00	**Other starting means; Starting aids not otherwise provided for**
46l-17/02	. Aiding engine start by thermal means, e.g. using lighted wicks (using electrically-heated glow-plugs 46k-19/02)
46l-17/04	. . by heating of fluids used in engines (heating of lubricants 14i-5/02)
46l-17/06	. . . by heating of engine coolants
46l-17/08	. Aiding engine start by other than thermal means
46l-19/00	**Electric starter motors**
46l-19/02	. combined with generators
46l-19/04	. combined with generators and ignition apparatus