

CPC**COOPERATIVE PATENT CLASSIFICATION****E21D****SHAFTS; TUNNELS; GALLERIES; LARGE UNDERGROUND**

CHAMBERS (soil-conditioning or soil-stabilising materials [C09K 17/00](#); drilling or cutting machines for mining or quarrying [E21C](#) ; safety devices, transport, rescue, ventilation or drainage [E21F](#))

WARNING

The following IPC groups are not used in the CPC scheme. Subject matter covered by these groups is classified in the following CPC groups:

[E21D 9/01](#) covered by [E21D 9/00](#)
[E21D 9/087](#) covered by [E21D 9/00](#)
[E21D 9/093](#) covered by [E21D 9/00](#)
[E21D 13/02](#) covered by [E21D 13/00](#)
[E21D 13/04](#) covered by [E21D 13/00](#)
[E21D 15/582](#) covered by [E21D 15/58](#)
[E21D 15/59](#) covered by [E21D 15/44](#), [E21D 15/58](#)
[E21D 17/022](#) covered by [E21D 17/02](#)
[E21D 17/05](#) covered by [E21D 17/02H](#), [E21D 17/04](#)
[E21D 17/054](#) covered by [E21D 17/04](#)
[E21D 19/06](#) covered by [E21D 19/02](#), [E21D 19/04](#)

Guidance heading: Shafts**E21D 1/00****Sinking shafts****E21D 1/02**

- . by hand

E21D 1/03

- . mechanically, {e.g. by loading shovels or loading buckets, scraping devices, conveying screws } ([E21D 1/08](#) takes precedence)

E21D 1/04

- .. with grabs { (boring grabs [E02F 3/44](#), [E21B 27/00](#); grab buckets for digging in general [E02F 3/47](#)) }

E21D 1/06

- .. with shaft-boring cutters (drilling machines [E21B](#) , [E21C](#))

E21D 1/08

- . while moving the lining downwards { (lowering the lining into a ready shaft [E21D 5/01](#); sheet piles [E02D 5/02](#)) }

E21D 1/10

- . Preparation of the ground { (for galleries or tunnels [E21D 9/001](#); improving or preserving foundation soil or rock [E02D 3/00](#)) }

E21D 1/105

- .. {by water level modification }

E21D 1/12

- .. by freezing { (freezing of foundation soil [E02D 3/115](#)) }

E21D 1/14

- ... Freezing apparatus

E21D 1/16

- .. by petrification (grouting anchoring-bolts [E21D 20/02](#); { consolidating foundation soil by placing solidifying or pore-filling substances in the soil [E02D 3/12](#) })

E21D 3/00**Raising shafts, i.e. working upwards from the bottom**

- E21D 5/00** **Lining shafts; Linings therefor** ([E21D 11/00](#) takes precedence; {sinking with simultaneous lowering of the lining [E21D 1/08](#) })
- [E21D 5/01](#) . using prefabricated lining lowered into a hole filled with liquid or viscous mass
- [E21D 5/012](#) . Use of fluid-tight or anti-friction material on outside of, or between, lining layers
- [E21D 5/016](#) . Bearer curbs
- [E21D 5/02](#) . with wood ([E21D 5/01](#), [E21D 5/012](#), [E21D 5/016](#) take precedence)
- [E21D 5/04](#) . with brick, concrete, stone, or similar building materials ([E21D 5/01](#), [E21D 5/012](#), [E21D 5/016](#) take precedence)
- [E21D 5/06](#) . with iron or steel ([E21D 5/01](#), [E21D 5/012](#), [E21D 5/016](#) take precedence)
- [E21D 5/08](#) . . in the form of profiled parts
- [E21D 5/10](#) . . in the form of tubing {or of rings composed of profile elements }
- [E21D 5/11](#) . with combinations of different materials, e.g. wood, metal, concrete ([E21D 5/01](#), [E21D 5/012](#), [E21D 5/016](#) take precedence)
- [E21D 5/12](#) . Accessories for making shaft linings, e.g. suspended cradles, shutterings
- E21D 7/00** **Shaft equipment, e.g. timbering within the shaft** { (lifts in hoistways or mines [B66B 15/00](#) to [B66B 19/00](#)) }
- [E21D 7/005](#) . {Determination of shaft lining deformation }
- [E21D 7/02](#) . Arrangement of guides for cages in shafts; Connection of guides for cages to shaft walls ([guideways or guides for elevators B66B 7/02](#))
- E21D 8/00** **Shafts not provided for in groups [E21D 1/00](#) to [E21D 7/00](#)**
- Guidance heading:** **Tunnels; Galleries; Large underground chambers; Linings therefor** (galleries protecting against falling rocks or avalanches [E01F 7/04](#); pressure galleries, galleries specially adapted to house pressure water conduits [E02B 9/06](#); tunnels or galleries specially adapted to house conduits in general [E02D 29/10](#); sewers [E03F](#))
- E21D 9/00** **Tunnels or galleries, with or without linings; Methods or apparatus for making thereof** ([E02D 29/045](#), [E02D 29/063](#) take precedence; linings per se [E21D 11/00](#)) ; **Layout of tunnels or galleries**
- [E21D 9/001](#) . {Improving soil or rock, e.g. by freezing; Injections (for sinking shafts [E21D 1/10](#); injection of liquids for binding dust [E21F 5/18](#); improving or preserving foundation soil or rock [E02D 3/00](#); borehole closures, i.e. packers, for use during the injection process [E21B 33/12](#)) }
- [E21D 9/002](#) . . {Injection methods characterised by the chemical composition used }
- [E21D 9/003](#) . {Arrangement of measuring or indicating devices for use during driving of tunnels, e.g.

- for guiding machines }
- E21D 9/004 . . {using light beams for direction or position control }
- E21D 9/005 . {by forcing prefabricated elements through the ground, e.g. by pushing lining from an access pit (driving shields [E21D 9/06](#)) }
- E21D 9/006 . {by making use of blasting methods (explosive compositions [C06B](#) ; blasting per se [F42](#)) }
- E21D 9/007 . {Methods or devices for restoring the cross-section of tunnels, e.g. by equalising the floor }
- E21D 2009/008 . Driving transverse tunnels starting from existing tunnels
- E21D 9/02 . Driving inclined tunnels or galleries
- E21D 9/04 . Driving tunnels or galleries through loose materials; Apparatus therefor not otherwise provided for { ([E21D 9/005](#), [E21D 9/06](#) take precedence; soil improvement [E21D 9/001](#); provisional protective covers [E21D 19/04](#)) }
- E21D 9/06 . Making by using a driving shield, {i.e. advanced by pushing means bearing against the already placed lining (pushing prefabricated elements through the ground from an access pit [E21D 9/005](#)) }
- E21D 9/0607 . . {the shield being provided with devices for lining the tunnel, e.g. shuttering ([E21D 9/082](#), [E21D 9/087](#) take precedence; tail sealing means used as end shuttering [E21D 9/0635](#)) }
- E21D 2009/0614 . . . with means for applying a continuous liner, e.g. sheets of plastics, between the main concrete lining and the rock
- E21D 9/0621 . . {Shield advancing devices }
- E21D 9/0628 . . {Control of the shields, e.g. of the hydraulic advancing cylinders (arrangement of measuring or indicating devices for use during driving of tunnels [E21D 9/003](#)) }
- E21D 9/0635 . . {Tail sealing means, e.g. used as end shuttering }
- E21D 2009/0642 . . the shield having means for additional processing at the front end
- E21D 2009/065 . . . with devices for provisionally supporting the front face
- E21D 2009/0657 . . . structurally associated with rock crushers
- E21D 2009/0664 . . . with means for applying a coating layer to the front face, e.g. by spraying
- E21D 2009/0671 . . . with means for consolidating the rock in front of the shield by injection of consolidating substances through boreholes
- E21D 2009/0678 . . . Adding additives, e.g. chemical compositions, to the slurry or the cuttings ([bentonite shall not be coded](#))
- E21D 2009/0685 Foaming agents
- E21D 9/0692 . . {Cutter drive shields }
- E21D 9/08 . . with additional boring or cutting means {other than the conventional cutting edge of the shield }
- E21D 9/081 . . . {with a rotary drilling head cutting simultaneously the whole front face }
- E21D 9/082 {the shield being provided with devices for lining the tunnel, e.g. shuttering }
- E21D 2009/084 . . . with rotary drilling heads having variable diameter
- E21D 9/085 . . . {with a movable support arm carrying cutting tools for attacking the front face, e.g. a bucket }

- E21D 9/087 {the shield being provided with devices for lining the tunnel, e.g. shuttering }
- E21D 2009/088 . . . for driving non-circular tunnels

- E21D 9/10 . Making by using boring or cutting machines ([E21D 9/08](#) takes precedence; mining picks [E21C 35/18](#))
- E21D 9/1006 . . {with rotary cutting tools (for cutting simultaneously the whole cross-section [E21D 9/11](#); drill bits [E21B 10/00](#)) }
- E21D 9/1013 . . . {on a tool-carrier supported by a movable boom }
- E21D 9/102 {by a longitudinally extending boom being pivotable about a vertical and a transverse axis }
- E21D 9/1026 {the tool-carrier being rotated about a transverse axis }
- E21D 9/1033 {by a transversely extending boom being pivotable about a longitudinal axis }
- E21D 9/104 . . . {Cutting tool fixtures (devices with percussive tools [E21D 9/106](#)) }
- E21D 9/1046 {Vibrating }
- E21D 9/1053 . . {for making a slit along the perimeter of the tunnel profile, the remaining core being removed subsequently, e.g. by blasting }
- E21D 9/106 . . {with percussive tools, e.g. pick-hammers }
- E21D 9/1066 . . {with fluid jets (projecting hot gases [E21D 9/1073](#); drilling by liquid or gas jets [E21B 7/18](#); slitting by liquid jets [E21C 25/60](#)) }
- E21D 9/1073 . . {applying thermal energy, e.g. by projecting flames or hot gases, by laser beams (flame drilling [E21B 7/14](#)) }
- E21D 9/108 . . {Remote control specially adapted for machines for driving tunnels or galleries (for machines for slitting or completely freeing the mineral [E21C 35/24](#)) }
- E21D 9/1086 . . {Drives or transmissions specially adapted therefor }
- E21D 9/1093 . . {Devices for supporting, advancing or orientating the machine or the tool-carrier (measuring devices for guiding machines [9/00C](#); anchoring in the borehole [E21B 4/18](#)) }

- E21D 9/11 . . with a rotary drilling-head cutting simultaneously the whole cross-section, i.e. full-face machines
- E21D 9/111 . . . {by means of heads or tool-carrying sectors implementing an oscillating rotary motion }
- E21D 9/112 . . . {by means of one single rotary head or of concentric rotary heads ([E21D 9/111](#) takes precedence) }
- E21D 9/113 {having a central part for making a pilot tunnel and a follow-up part for enlarging the pilot tunnel ([E21D 9/115](#) takes precedence; similar apparatus for enlarging drilled boreholes [E21B 7/28](#)) }
- E21D 9/115 {with cutting tools mounted pivotably or slidable on the head }
- E21D 9/116 . . . {by means of non-concentric rotary heads ([E21D 9/111](#) takes precedence) }
- E21D 9/117 {mounted for orientating or sideways shifting relative to the frame }
- E21D 9/118 {with independently driven central head }

- E21D 9/12 . Devices for removing or hauling away excavated material or spoil; Working or loading platforms ([underground transport E21F 13/00](#))
- E21D 9/122 . . {Working or loading platforms ([underground transport E21F 13/00](#)) }
- E21D 9/124 . . {Helical conveying means therefor ([E21D 9/13](#) takes precedence) }
- E21D 9/126 . . {Loading devices or installations (loading platforms [E21D 9/122](#); soil-shifting machines [E02F 3/00](#)) }
- E21D 9/128 . . . {Loader-conveyers with gathering arms }

- E21D 9/13 . . using hydraulic or pneumatic conveying means

- E21D 9/14 . Layout of tunnels or galleries; Constructional features of tunnels or galleries, not otherwise provided for, e.g. portals, day-light attenuation at tunnel openings

- E21D 11/00** **Lining tunnels, galleries or other underground cavities, e.g. large underground chambers; Linings therefor; Making such linings in situ, e.g. by assembling ([E21D 15/00](#) to [E21D 23/00](#) take precedence; specially for shafts [E21D 5/00](#); {driving shields in combination with means for lining the tunnel [E21D 9/06](#) }; lining pressure water galleries, linings therefor [E02B 9/06](#))**

- E21D 11/003 . {Linings or provisions thereon, specially adapted for traffic tunnels, e.g. with built-in cleaning devices ([E21D 11/38](#) takes precedence) }

- E21D 11/006 . {Lining anchored in the rock (setting anchoring-bolts [E21D 20/00](#); anchoring-bolts [E21D 21/00](#)) }

- E21D 11/02 . Lining predominantly with wood
- E21D 11/03 . . using timber- setting machines

- E21D 11/04 . Lining with building materials ([E21D 11/02](#), [E21D 11/14](#) take precedence; {compositions of mortars, concrete or like building materials [C04B](#) ; placing filling-up materials in underground workings [E21F 15/00](#) })

- E21D 11/05 . . using compressible insertions
- E21D 11/06 . . with bricks
- E21D 11/07 . . . using brick- laying machines { (brick-laying machines per se [E04G 21/22](#)) }
- E21D 11/08 . . with preformed concrete slabs { (backfilling the space between the slabs and the rock [E21D 11/105](#)) }
- E21D 11/083 . . . {Methods or devices for joining adjacent concrete segments }
- E21D 2011/086 . . . Making of concrete lining segments
- E21D 11/10 . . with concrete cast in situ; Shuttering {also lost shutterings, e.g. made of blocks, of metal plates } or other equipment adapted therefor
- E21D 11/102 . . . {Removable shuttering; Bearing or supporting devices therefor }
- E21D 11/105 . . . {Transport or application of concrete specially adapted for the lining of tunnels or galleries (in building [E04F 21/08](#), [E04G 21/02](#)) ; Backfilling the space between main building element and the surrounding rock, e.g. with concrete }
- E21D 11/107 . . . {Reinforcing elements therefor; Holders for the reinforcing elements }
- E21D 11/12 . . Temporary supports for use during building {removable shutterings [E21D 11/102](#) ; Accessories { (provisional protective covers [E21D 19/04](#)) }

- E21D 11/14 . Lining predominantly with metal { (backfilling the space between the lining elements and the rock [E21D 11/105](#)) }

- E21D 11/15 . . Plate linings; Laggings, i.e. linings designed for holding back formation material or for transmitting the load to main supporting members ([insulation](#)[E21D 11/38](#))
- E21D 11/152 . . . {Laggings made of grids or nettings }
- E21D 11/155 . . . {Laggings made of strips, slats, slabs or sheet piles (longitudinal struts for mine arches [E21D 11/28](#)) }
- E21D 11/157 . . . {Laggings making use of fluid cushions, e.g. the fluid containing a hardenable material (chocks made of flexible containers [E21D 15/483](#)) }
- E21D 11/18 . . Arch members; {Network made of arch members ([E21D 11/36](#) takes precedence) ;

- Ring elements; Polygon elements; Polygon elements inside arches (caps for arches [E21D 17/00](#)) }
- E21D 11/183 . . . {Supporting means for arch members, not provided for in [E21D 11/22](#) }
 - E21D 11/186 . . . {Pre-stressing or dismantling devices therefor }
 - E21D 11/20 . . . Special cross- sections, e.g. corrugated { (for props [E21D 15/502](#); for caps [E21D 17/01](#)) }
 - E21D 11/22 . . . Clamps or other yieldable means for interconnecting adjacent arch members either rigidly, or allowing arch member parts to slide when subjected to excessive pressure
 - E21D 11/24 . . . Knuckle joints or links between arch members
 - E21D 11/26 . . . Shoes for connecting arch members to longitudinal struts
 - E21D 11/28 . . Longitudinal struts, {i.e. longitudinal connections between adjoining arches }
 - E21D 11/30 . . Bases for lower arch members (for props [E21D 15/54](#))
 - E21D 11/34 . . Joints between vertical props and horizontal top bars (end caps forming part of the props [E21D 15/54](#); {retaining plates on caps for engaging the tops of pit-props [E21D 17/10](#) })
 - E21D 11/36 . . Linings or supports specially shaped for tunnels or galleries of irregular cross-section
 - E21D 11/362 . . . {for loading areas (lining shafts [E21D 5/00](#)) }
 - E21D 11/365 . . . {for intersecting galleries }
 - E21D 11/367 . . . {for junction with the longwall coal face (walking supports therefor [E21D 23/0091](#)) }
 - E21D 11/38 . . Waterproofing (in general [E02D 31/00](#)) ; Heat insulating; Soundproofing; Electric insulating (for building constructions in general [E04B 1/62](#))
 - E21D 11/381 . . {Setting apparatus or devices }
 - E21D 11/383 . . {by applying waterproof flexible sheets; Means for fixing the sheets to the tunnel or cavity wall }
 - E21D 11/385 . . {Sealing means positioned between adjacent lining members (for joints in foundation structures [E02D 29/16](#); for sewers [E03F 3/04](#); for building structures in general [E04B 1/68](#)) }
 - E21D 2011/386 . . . inflatable
 - E21D 2011/388 . . . having longitudinal cavities communicating with the exterior on the outer side of the lining elements
 - E21D 11/40 . . Devices or apparatus specially adapted for handling or placing units of linings {or supporting units } for tunnels or galleries { (combined with tunnelling shields [E21D 9/06](#)) }
 - E21D 11/403 . . {combined with the head machine }
 - E21D 2011/406 . . Placing endless lining elements, e.g. from reels (in combination with a tunnelling shield [E21D 2009/0614](#))
 - E21D 13/00 **Large underground chambers; Methods or apparatus for making them** (lining [E21D 11/00](#))

Guidance heading: Working-face supports

- E21D 15/00 **Props** (in the building art [E04G 25/00](#)) ; **Chocks**, {e.g. made of flexible containers filled with backfilling material }

- E21D 15/002 . {Auxiliary devices in which the prop type is not essential (setting or withdrawing props or chocks [E21D 15/58](#), [E21D 15/60](#)) }
- E21D 15/005 . {characterised by the material }
- E21D 15/007 .. {spark-reducing }
- E21D 15/02 . Non-telescopic props
- E21D 15/04 .. with wooden prop parts joined by double conical connectors
- E21D 15/06 .. with parts joined by a lock, with or without slight axial adjustability
- E21D 15/08 ... with toggle joint connection
- E21D 15/10 ... with dog-clutch or pin-and-hole connection
- E21D 15/12 ... with locking devices located near head or foot { ([E21D 15/08](#) and [E21D 15/10](#) take precedence) }
- E21D 15/14 . Telescopic props (general means for fixing telescopic parts together {[F16B 7/10](#) })
- E21D 15/15 .. Means counteracting entry of dirt; Built-in cleaning devices
- E21D 15/155 ... {Built-in cleaning devices }
- E21D 15/16 .. with parts held together by positive means, with or without relative sliding movement when the prop is subject to excessive pressure
- E21D 15/18 ... with one part resting on a supporting medium, e.g. rubber, sand, bitumen, lead, located in the other part, with or without expulsion or displacement of the medium upon excessive pressure { (clamping pressure between telescopic prop elements by means of granular material [E21D 15/303](#)) }
- E21D 15/20 ... with pawl, pin, cross-piece, or the like engaging with ratchet teeth, notches, holes, or the like, spaced apart at intervals
- E21D 15/22 ... with member, pin, cross- piece, or the like, ruptured, sheared through, or permanently deformed upon excessive pressure
- E21D 15/24 ... with axial screw-and-nut, rack-and-worm, or like mechanism
- E21D 15/26 with screw, worm, or the like, not self-locking but normally prevented from rotation by friction members which slip upon excessive pressure
- E21D 15/28 .. with parts held relatively to each other by friction or gripping
- E21D 15/285 ... {by means of wedges or wedge combinations (details of wedges [E21D 15/43](#)) }
- E21D 15/30 ... by means expanded or contracted by pressure applied through the medium of a fluid or quasi- fluid, e.g. rubber { (setting props [E21D 15/588](#), [E21D 15/589](#)) }
- E21D 15/303 {by means of granular material (supporting by means of granular material [E21D 15/18](#)) }
- E21D 15/306 {by means of a liquid }
- E21D 15/32 ... by a deformable collar {or clamping means applied symmetrically inside a locking ring }
- E21D 15/325 {by a clamping ring }
- E21D 15/34 ... by axially- moving balls, rollers, or the like
- E21D 15/36 ... by a tiltable collar surrounding one or both parts
- E21D 15/38 ... with longitudinally-divided upper or lower prop parts, e.g. interfitting laminations
- E21D 15/40 ... Collar or other support gripped to one or both parts by toggle-action, cam, or other member pivoted or similarly mounted
- E21D 15/42 ... with special parts to influence the friction
- E21D 15/43 ... Details of wedges (friction linings or pads [E21D 15/42](#))

- E21D 15/435 {hydraulic }
- E21D 15/44 . . Hydraulic, pneumatic, or hydraulic-pneumatic props {see also [E21D 15/51](#) }
- E21D 15/445 . . . {comprising a fluid cushion }
- E21D 15/45 . . . having closed fluid system, e.g. with built-in pumps or accumulators
- E21D 15/46 . . with load-measuring devices; with alarm devices
- E21D 15/465 . . . {with essential hydraulic or pneumatic details }

- E21D 15/48 . Chocks or the like
- E21D 15/483 . . {made of flexible containers, e.g. inflatable, with or without reinforcement, e.g. filled with water, backfilling material or the like (laggings making use of fluid cushions [E21D 11/157](#)) }
- E21D 15/486 . . {with essential hydraulic or pneumatic details }

- E21D 15/50 . Component parts or details of props ([E21D 15/43](#), [E21D 15/58](#), [E21D 15/60](#) take precedence)
- E21D 15/502 . . Prop bodies characterised by their shape, e.g. of specified cross-section
- E21D 15/51 . . specially adapted to hydraulic, pneumatic, or hydraulic-pneumatic props, e.g. arrangements of relief valves {not used, see subgroups and [E21D 15/44](#) }
- E21D 15/512 . . . {Arrangement of valves (external control of roof support installations [E21D 23/12](#), [E21D 23/26](#)) }
- E21D 15/515 . . . {Particular fluids not covered by any chemical subdivision }
- E21D 15/517 . . . {Extension elements }
- E21D 15/52 . . Extensible units located above or below standard props (for allowing step-by-step movement of cap [E21D 23/06](#); setting props or chocks [E21D 15/58](#))
- E21D 15/523 . . . {with hydraulic or pneumatic control }
- E21D 15/526 . . . {for step-by-step extension of the prop }
- E21D 15/54 . . Details of the ends of props (for permitting step-by-step movement [E21D 23/06](#))
- E21D 15/545 . . . {hydraulic or pneumatic }
- E21D 15/55 . . . of prop heads {or feet }
- E21D 15/56 . . Details of locks of telescopic props
- E21D 15/563 . . . {by which a series of similarly shaped props can obtain an almost equal load-capacity (setting props or chocks [E21D 15/584](#), [E21D 15/589](#)) }
- E21D 15/566 . . . {comprising a fluid cushion }

- E21D 15/58 . Devices for setting props or chocks
- E21D 15/581 . . {in which the props are pre- loaded (extensible elements at strut extremities [E21D 15/52](#)) }
- E21D 15/582 . . . {by means of power accumulators to be pre-charged by rock pressure (by means of hydraulically operated devices [E21D 15/587](#)) }
- E21D 15/583 . . . {in which the lock is also activated }
- E21D 15/584 . . {in which a series of similarly shaped props obtain an almost equal load capacity by removable devices (idem for extensible props [E21D 15/563](#)) }
- E21D 15/585 . . {by means of hydraulically operated devices for mechanical props, or hydraulic props in which the hydraulic part is not important (hydraulic props in which the hydraulic part is important [E21D 15/44](#)) }
- E21D 15/586 . . . {the props being pre-loaded }
- E21D 15/587 {by means of power accumulators to be pre-charged by rock pressure }

- E21D 15/588 {the lock also being activated }
- E21D 15/589 . . . {in which a series of similarly shaped props are given almost equal load capacity by removable devices }

- E21D 15/60 . Devices for withdrawing props or chocks
- E21D 15/603 . . {by means of hydraulic devices }
- E21D 15/606 . . { the props being moved systematically (mine roof supports for step-by-step movement [E21D 23/00](#)) }

- E21D 17/00 Caps for supporting mine roofs**

- E21D 17/003 . {with essential hydraulic elements }
- E21D 17/006 . {characterised by the material }
- E21D 17/01 . characterised by the shape of the cap, e.g. of specified cross-section
- E21D 17/02 . Cantilever extension or similar protecting devices
- E21D 17/0206 . . {Hydraulically operated extension devices }
- E21D 17/0213 . . {Assembling devices for pivoting caps upwardly }
- E21D 17/03 . . Brackets for roof-supporting bars
- E21D 17/04 . . for use in longwall working
- E21D 17/06 . . for use in drifting galleries
- E21D 17/08 . . Cap joints for obtaining a coal-face free of pit-props
- E21D 17/082 . . . of sliding type
- E21D 17/086 . . . or articulated type

- E21D 17/10 . Details of mine caps for engaging the tops of pit-props, with or without retaining-plates; Retaining-plates

- E21D 19/00 Provisional protective covers for working space ([E21D 9/06](#), [E21D 23/00](#) take precedence)**

- E21D 19/02 . for use in longwall working
- E21D 19/04 . for use in drifting galleries

- E21D 20/00 Setting anchoring-bolts (anchoring bolts for shafts, tunnels or galleries [E21D 21/00](#); means for anchoring structural elements or bulkheads specially adapted to foundation engineering [E02D 5/74](#); dowels or other devices fastened in walls or the like by inserting them in holes made therein for that purpose [F16B 13/00](#))**

- E21D 20/003 . {Machines for drilling anchor holes and setting anchor bolts }
- E21D 20/006 . . {having magazines for storing and feeding anchoring-bolts (combined feeding from racks and connecting of drill rods or the like [E21B 19/20](#)) }

- E21D 20/02 . with provisions for grouting
- E21D 20/021 . . {Grouting with inorganic components, e.g. cement }

- E21D 20/023 . . . {Cartridges; Grouting charges }
 - E21D 20/025 . . {Grouting with organic components, e.g. resin }
 - E21D 20/026 . . . {Cartridges; Grouting charges }
 - E21D 20/028 . . {Devices or accessories for injecting a grouting liquid in a bore-hole ([E21D 20/003](#) takes precedence; improving soil or rock by injections [E21D 9/001](#)) }
- E21D 21/00** **Anchoring-bolts for roof, floor {in galleries or longwall working }, or shaft-lining protection ({ground anchors [E02D 5/80](#); anchorings for building constructions [E04B 1/41](#), [E21D 2/30](#) }; dowels or other devices fastened in walls or the like by inserting them in holes made therein for that purpose [F16B 13/00](#); {bolts with visible load [G01L 1/00](#) })**
- E21D 21/0006 . {characterised by the bolt material }
 - E21D 21/0013 . {Protection against corrosion }
 - E21D 21/002 . {using explosives charges }
 - E21D 21/0026 . {characterised by constructional features of the bolts }
 - E21D 21/0033 . . {having a jacket or outer tube }
 - E21D 21/004 . . {Bolts held in the borehole by friction all along their length, without additional fixing means }
 - E21D 21/0046 . . {formed by a plurality of elements arranged longitudinally }
 - E21D 2021/0053 . . Anchoring-bolts in the form of lost drilling rods
 - E21D 2021/006 . . Anchoring-bolts made of cables or wires
 - E21D 2021/0066 . . Anchoring-bolts formed by a bundle of radially arranged rigid elements
 - E21D 2021/0073 . . Anchoring-bolts having an inflatable sleeve, e.g. hollow sleeve expanded by a fluid
 - E21D 21/008 . {Anchoring or tensioning means }
 - E21D 21/0086 . {Bearing plates }
 - E21D 21/0093 . {Accessories }
 - E21D 21/02 . having means for indicating tension ([screwed connections specially modified for indicating tensile load \[F16B 31/02\]\(#\)](#))
- E21D 23/00** **Mine roof supports for step- by- step movement, e.g. in combination with provisions for shifting of conveyers, mining machines, or guides therefor [(N: transport of mine roof support units [E21F 13/008](#); shifting of mine conveyers at the working face [E21F 13/08](#))]**
- E21D 23/0004 . {along the working face }
 - E21D 23/0008 . . {comprising a pair of joined struts }
 - E21D 23/0013 . . {Frame type supports }
 - E21D 23/0017 . . {Pile type supports }
 - E21D 23/0021 . . . {comprising two walking elements }
 - E21D 23/0026 . . . {comprising three walking elements }
 - E21D 23/003 . . . {consisting of a rigid pile }

- E21D 23/0034 . . {comprising a goaf shield articulated to a base member }
- E21D 23/0039 . . . {and supported by a strut or by a row of struts parallel to the working face }
- E21D 23/0043 . . . {and supported by two or more rows of struts parallel to the working face }

- E21D 23/0047 . {without essential shifting devices }

- E21D 23/0052 . {with advancing shifting devices connected therewith }

- E21D 23/0056 . {with individual advancing shifting devices }

- E21D 23/006 . {provided with essential hydraulic devices }
- E21D 23/0065 . . {driven, or automatically, e.g. electrically-hydraulically controlled }
- E21D 23/0069 . . {without essential advancing shifting devices }
- E21D 23/0073 . . {with advancing shifting devices connected therewith }
- E21D 23/0078 . . {with individual shifting devices }

- E21D 23/0082 . {specially adapted for vertical or steep gradient seams }

- E21D 23/0086 . {in galleries }
- E21D 23/0091 . . {at the junction with the working face }
- E21D 23/0095 . . {Temporary supports at the driving front }

- E21D 23/03 . having protective means, e.g. shields, for preventing or impeding entry of loose material into the working space or support

- E21D 23/04 . Structural features of the supporting construction, e.g. linking members between adjacent frames or sets of props; Means for counteracting lateral sliding on inclined floor ([E21D 23/14 takes precedence](#))

- E21D 23/0409 . . {Aligning or guiding means for the supports or for the constitutive parts of the supports }
- E21D 23/0418 . . {Positioning devices and stabilizing means for the props }
- E21D 23/0427 . . {Shield operating devices; Hinges therefor }
- E21D 23/0436 . . {Means for inclining the base member of the support }
- E21D 23/0445 . . {Extensions of the base member supporting the conveyer }
- E21D 23/0454 . . {Trailing plates; Coal face or goaf side sprags ([specially adapted for the placing of filling-up materials E21D 23/0481](#)) }
- E21D 23/0463 . . {Hanging or shifting means for tubes, electric feeding cables or the like }
- E21D 23/0472 . . {Supports specially adapted for people walking or transporting material }
- E21D 23/0481 . . {Supports specially adapted for use in combination with the placing of filling-up materials ([placing filling-up materials in underground workings per se E21F 15/00](#)) }

WARNING

Group [E21D 23/0481](#) is not complete. See also other groups of [E21D 23/00](#)

- E21D 23/049 . . {Connecting devices between the head or foot of a prop and the cap or base of the roof support }

- E21D 23/06 . . Special mine caps or special tops of pit-props for permitting step-by-step movement

- E21D 23/063 . . . {Retractable cantilever extensions therefor }
- E21D 23/066 . . . {Pivoted cantilever extensions therefor }

- E21D 23/08 . Advancing mechanisms ([E21D 23/16](#) takes precedence)
- E21D 23/081 . . {forming parts of the roof supports }
- E21D 23/082 . . . {acting solely on the elements of the supports }
- E21D 23/083 . . . {acting on a firm abutment adapted thereto }
- E21D 23/085 . . . {acting on a conveyer or a guide for the mining machine }
- E21D 23/086 {Details of fixing devices therefor }
- E21D 23/087 . . . {acting directly on the walls of the seam }
- E21D 23/088 {by means of wheels, rollers, caterpillars, belts or worm screws }
- E21D 23/10 . . with advancing devices separate from the supporting construction

- E21D 23/12 . Control, e.g. using remote control ([E21D 23/16](#) takes precedence)
- E21D 23/14 . . Effecting automatic sequential movement of supports, e.g. one behind the other ({advancing of mining machines toward the working face [E21C 29/02](#); advancing of conveyers toward the working face [E21D 23/085](#) })

- E21D 2023/142 . . . Measuring the advance of support units with respect to external points of reference
- E21D 2023/144 . . . Measuring the advance of support units with respect to internal points of reference, e.g. with respect to neighbouring support units or extension of a cylinder

- E21D 2023/146 . . . Transmission of signals and commands by cable
- E21D 2023/148 . . . Wireless transmission of signals and commands

- E21D 23/16 . Hydraulic or pneumatic features, e.g. circuits, arrangement or adaptation of valves, setting or retracting devices
- E21D 23/18 . . of advancing mechanisms
- E21D 23/20 . . . for sequential movement, e.g. one behind the other
- E21D 23/22 . . . incorporated in mine caps
- E21D 23/24 . . . the advancing mechanisms being separate from the supporting construction
- E21D 23/26 . . Hydraulic or pneumatic control