I. Catalysts
a) Catalysts: General

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3066	2/14/25	Fr 616,237 Brit 247,582 Brit 272,829 US 1,876,009 US 1,890,434 US 1,931,549 US 2,005,192 US 1,931,550 US 1,983,234 US 1,996,009 US 2,006,996 US 1,994,075	Pressure hydrogenation of coal in presence of nitrogen compounds (ammonia, ammonium sulfide, nitride, as catalysts).
3067	2/14/25	Germ 608,466 Fr 616,237 Brit 247,583 Brit 272,830	Pressure hydrogenation of coal in presence of molybdenum, and its compounds as catalysts.
3068	2/14/25	Germ 633,185 Fr 616,237 Brit 247,584 Brit 272,831 US 1,923,576	Pressure hydrogenation of coal in presence of sulfur compounds, sulfides, sulfates, sulfites, or sulfur + metal or oxide as catalysts.
3072	2/16/25	Germ 619,739 Fr 616,237 Brit 247,585 Brit 272,832 US 1,923,576	Pressure hydrogenation of tar, in presence of sulfur compounds as catalysts.
3073 8588	2/16/25	Germ 609,538 Fr 616,237 Brit 247,586 Brit 272,833 US 1,890,436	Pressure hydrogenation of tar in presence of molybdenum and its compounds as catalysts.
3074	2/16/25	Fr 616,237 Brit 247,587 Brit 272,834 US 1,876,009 US 1,890,434 US 1,931,549	Pressure hydrogenation of tar in presence of nitrogen compounds as catalysts.

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		US 2,005,192	
		US 1,931,550	
		US 1,983,234	
		US 1,996,009	
		US 2,006,996	
		US 1,994,075	
3120	3/19/25	Germ 664,563	Pressure hydrogenation of mineral oils in presence of sulfur compounds, in particular metal sulfides as catalysts.
		Fr 616,237	
		Brit 249,493	
		Brit 273,228	
		US 1,923,576	
3121	3/19/25	Germ 643,141	Pressure hydrogenation of mineral oils in presence of molybdemum and its compounds as catalysts.
		Fr 616,237	
		Brit 249,501	
		Brit 274,401	
		US 1,890,436	
3154	4/15/25	Fr 616,237	Pressure hydrogenation mineral oils in presence of nitrogen-containing or ammonia forming catalysts.
		Brit 250,948	
		Brit 272,835	
		US 1,876,009	
		US 1,890,434	
		US 1,931,549	
		US 2,005,192	
		US 1,931,550	
		US 1,983,234	
		US 1,996,009	
		US 2,006,996	
		US 1,994,075	
3166 8863	4/25/25	Germ 657,703	Pressure hydrogenation of coal, tars, mineral oils in presence of tungsten and chromium and their compounds as catalysts.
		Fr 616,237	
		Brit 251,264	
		US 1,876,009	
		US 1,890,434	
		US 1,931,549	
		US 2,005,192	
		US 1,931,550	
		US 1,983,234	
		US 1,996,009	
		US 2,006,996	
		US 1,994,075	

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3266	8/20/25	Germ 671,606 Fr 32,139 Fr 616,237 Brit 257,256 US 1,876,009 US 1,890,434 US 1,931,549 US 2,005,192 US 1,931,550 US 1,983,234 US 1,996,009 US 2,006,996 US 1,994,075	Pressure hydrogenation of coals, tars, mineral oils in presence of methanol-forming catalysts.
3283	9/10/25	Germ 577,835 Fr 32,139 Fr 616,237 Brit 258,272 Brit 285,923 Brit 286,678 Brit 286,679 Brit 286,680 Brit 286,681 US 1,876,009 US 1,890,434 US 1,931,549 US 2,005,192 US 1,931,550 US 1,983,234 US 1,996,009 US 2,006,996 US 1,994,075	Pressure hydrogenation in presence of Ag, Cu, Cd, Pb, Bi, Sn, in free or combined form, or of difficult -to- reduce metal oxides (except alkalies, alkaline earths, but including lithium), in particular of the IV group, carbonates of Mg, Li, boric acid, alumina or rare earths. Oxides or carbonates of Zn, U, Mn, or V, possibly with metals of the VIII group, e.g. Fe.
3638	6/29/26	Germ 626,171 Fr 634,822 Brit 273,712 US 1,922,542	Pressure hydrogenation of coals, tars, mineral oils, with the use of splitting catalysts in the beginning, then hydrogenating acting catalysts.
3678	7/24/26	Fr 638,109 Brit 274,904 US 1,845,058	Catalytic pressure hydrogenation with violent motion of catalysts
3699	8/7/26	Fr 33,972 Fr 616,237 Brit 275,663 Brit 293,719	Pressure hydrogenation of coals, tars, mineral oils in presence of the elements and compounds of the IV - VIII group (Mo) together with

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3699	8/7/26	Brit 293,720 Brit 295,947 Brit 295,948 Brit 295,949	the elements of the II - VII group or Cu or Au or their compounds. The elements of the IV - VII groups are used generally in smaller amounts.
3700 8836	8/7/26	Germ 677,104 Fr 33,972 Fr 616,237 Brit 275,664 Brit 299,020 Brit 299,021 US 1,938,542	Pressure hydrogenation in presence of carbides, activated charcoal or non-metals, such as boron, silicon, phosphorus, arsenic, selenium, tellurium or halogens, free or in combined form, if necessary with the elements of the II - VIII group, in particular of the VI group.
3701	8/9/26	Fr 33,972 Fr 616,237 Brit 275,670 Brit 295,587 US 1,845,439	Pressure hydrogenation in presence of noble metals, or lead, or tin upon carriers such as MgO or Cr_2O_3 as catalysts.
3712	8/11/26	Fr 33,972 Fr 616,237 Brit 276,001 Brit 300,703 US 1,845,555	Ag, Cu, Zn, Cd, as metals or in combination, as additions to pressure hydrogenation catalysts.
4025	3/3/27	Fr 650,237 Brit 286,284 US 1,776,875	Catalyst preparations of high mechanical strength obtained by the addition of water soluble magnesium salts.
4096	3/31/27	Germ 568,626 Fr 651,891 Brit 307,946 US 1,844,998	Pressure hydrogenation of coals, tars, mineral oils in presence of oxides of metals of the III - VII group, precipitated upon metals as catalysts.
4276	7/30/27	Germ 489,279 Brit 311,251	Pretreatment of catalysts with non-reducing gases.
4517	1/6/28	Germ 595,234 Fr 650,237 Brit 326,580 US 1,946,108 US 1,946,109	Catalyst composition of high mechanical strength obtained by the addition of metals of the II, III or VIII groups.

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5102 10380	9/24/28	Fr 685,564 Brit 331,558 US 1,922,499 US 1,937,588	Pressure hydrogenation catalysts containing three different metals, two of which belong to groups higher than the IV.
5535	4/18/29	Fr 693,054 Brit 337,046 US 1,876,270	Complex metallo-organic compounds as catalysts.
5851	8/21/29	Germ 670,717 Fr 38,949 Fr 616,237 Brit 348,690 US 1,955,829	Preparation of metal sulfides from metals or oxides with volatile sulfur compounds + hydrogen.
6388 7570	4/25/30	Fr 715,896 Brit 364,586	Pressure hydrogenation in presence of metals of the VI group or the VIII group, obtained from their carbonyl compounds, or from oxides or sulfides of these metals.
6442	5/19/30	Fr 716,239	Metal oxides obtained from metal carbonyls used as catalysts.
6537	6/30/30	Fr 717,301 Brit 364,655 US 1,996,008	Pressure hydrogenation in presence of iron activated by CO, or Ni.
6633 6636	8/19/30 8/20/30	Germ 556,797 Fr 718,345 Brit 364,785 US 2,091,831	Oil soluble molybdenum compounds, obtained by heating molybdenum chloride with high molecular weight acids or phenols dissolved in oils, used as catalysts for the pressure hydrogenation.
6792	10/31/30	Germ 692,813 Fr 725,070 Brit 371,833 US 2,002,997 US 2,058,789	Molybdenum and/or tungsten-containing catalysts in the form of their complex compounds, to be used as catalysts for the pressure hydrogenation.
6868	12/17/30	Germ 612,911 Fr 724,905 Brit 374,250 US 1,911,505	Production of molybdenum, tungsten, and vanadium from ores by treatment with chlorine or hydrogen chloride in mixtures of carbonaceous materials in equipment of alloy steel.

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6935. 10,870	1/30/31	Germ 685,371 Fr 728,913 Fr 794,936 Brit 379,335 US 2,038,599 US 2,039,259 US 2,122,382 US 2,127,383	Metal sulfides obtained by the decomposition of sulfo salts, or from metal sulfides of other sources, retreated with sulfur compounds, used as catalysts for pressure hydrogenation
" " 7017	3/26/31	Fr 728,913 Fr 728,936 Brit 379,335 US 2,038,599 US 2,039,259 US 2,127,382 US 2,127,383	Metal sulfides obtained by treating metals or compounds with sulfur or volatile sulfur compounds under pressure to be used as catalysts for pressure hydrogenation
" 7061	4/18/31	Germ 589,968 Fr 735,295 Brit 389,573	The use of such tungsten, molybdenum, or vanadium compounds as catalysts, which are pseudomorphic with other compounds of these metals.
" 7110	" 8/7/26	Germ 663,374	Pressure hydrogenation in presence of silicon, silicide, silica or other nitrogen-free silicon compounds,
" 7145	" 7/11/31	Fr. 738,349	Treating catalysts prior to their use for a longer time at increasing or step-wise increasing temperature with hydrogen or carbon-containing gases or vapors.
" " 7173 8425	" 7/29/31 5/20/32	Germ 648,130 Fr 740,493 Brit 381,367	Addition of finely divided catalysts only after the preheating of the raw materials to be hydrogenated.
" " 7174	8/1/31	Germ " 570,951 Fr. 738,995	Mixing or saturating coal with catalysts, adding catalysts to the oil, then mixing the coal and the oil and pressure hydrogenating.
" 7233	9/3/31	Germ " " 577,628 Fr 740,445 US 1,998,626	Heating under pressure to sintering of fusion of volatile molybdenum and tungsten compounds decomposable under heat.

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7312	11/6/31	Germ	626,462	The addition of finely divided catalysts during the working-up of the constituents.
		Fr	740,493	
		Brit	381,367	
7493	3/9/32	Germ	699,656	Oxygen acids of sulfur and nitrogen, also carboxy acids and sulfo acids with metallic compounds as catalysts
10,917		Fr	750,296	
10,918		US	2,191,156	
10,919				
7570		Germ	579,565	See O.Z. 6388
7682	8/26/32	Germ	633,825	Suspension of catalysts in an asphalt-free oil, miscible with the materials to be hydrogenated, and notflocculating the asphalts.
		Fr	763,220	
		Brit	400,844	
		US	2,054,776	
7728	10/14/32	Germ	651,473	Treating the catalysts carrier with hydrogen at elevated temperatures under pressure before the addition of the catalyst substances.
		Fr.	762,324	
		Brit	402,938	
7732	10/18/32	Germ	603,763	Acidifying the catalyst carrier in presence of a wetting agent before the deposition of the catalyst substances.
		Fr	44,183	
		Fr	750,296	
		Brit	409,824	
7841	1/17/33	Fr	44,441	Treating the catalyst-carrier at temperatures above 500°C with other gases than hydrogen under pressure before depositing the catalytic substance.
		Fr	762,324	
		Brit	417,527	
		US	2,100,352	
8190	12/9/33	Fr	782,388	Carbon-containing catalyst carriers, wholly or partially free from ash constituents.
8233	1/11/34	Germ	693,985	Use of metal sulfides as catalysts, prepared by conversion of sulfo salts with metal compounds in water solution or in the presence of organic solvents.
		Fr	45,949	
		Fr	728,913	
		Fr	794,936	
		Brit	434,141	
		US	2,159,511	
8248	1/23/34	Germ	706,826	Mixing of finely divided catalytic materials with liquids, driving off the liquids, grinding the mass,
		Fr	784,503	
		US	2,204,619	

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8248			adding solids, and compressing into shapes (preparation of the catalysts 3510).
8306	3/14/34	Germ 647,858 Fr 785,459	Obtaining readily filterable alumina by interaction of ammonium carbonate upon solid water soluble aluminum salts in the presence of small amounts of water.
8325	3/29/34		Preparation of alumina by conversion of alumina salts with NH_3, eliminating the liquid constituents, careful drying, washing, drying and calcining.
8425		Germ 660,074	See O.Z. 7173
8456	7/11/34	Fr 793,436 Brit 442,573	Molybdenum and tungsten catalysts sulfurized with the addition of NH_3 with volatile sulfur compounds, conveniently under pressure.
8483	7/27/34	Fr 793,108 Brit 457,198	Saturating coal with water solution of halogen compounds of nickel or of any soluble compounds of iron or cobalt, then pressure hydrogenating, possible with the addition of alkalies.
8490	8/2/34	Germ 695,210 Fr 793,227 Brit 455,453	Pressure hydrogenation of middle oils or of high-boiling hydrocarbons in presence of strongly hydrogenating catalysts (sulfides) and small amounts of basic acting materials.
8526	8/30/34	Germ 664,385 Fr 794,437 Brit 446,114	Germanium or its compounds together with sulfur or its compounds used as catalysts.
8554	9/25/34	Fr 806,743 Brit 458,856	Lead salts of organic acids except lead oleate used as catalysts.
8588	See O.Z. 3073		See O.Z. 3073
8603	10/26/34	Germ 695,270 Fr 796,987 Brit 454,391 US 2,127,577	Pressure hydrogenation in presence of catalysts, obtained by oxidative de-hydrogenation of solid carbon-containing materials below 300°C, e.g. with graphitic acids

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8620	11/10/34	Germ 695,271 Fr 797,911 Brit 459,268	Pressure hydrogenation of coal with the addition before the reaction of liquid oxygen-free sulfur compounds or of liquid sulfur or solutions of sulfur or of metal or oxygen-free sulfur compounds of non acid character.
8621	11/10/34	Germ 695,272 Fr 797,911 Brit 459,268	Pressure hydrogenation of coal by treating before the reaction with sulfur vapors or with volatile oxygen-free sulfur compounds or with oxygen-containing organic sulfur compounds in volatile form.
8711	1/12/35	Fr 793,108	Pressure hydrogenation of coal with finely divided metallic iron + alkalies.
8836		Germ 650,087	See O. Z. 3700
8863		Germ 669,015	See O. Z. 3166
8962	7/20/35	Fr 47,511 Fr 793,108	Pressure hydrogenation of coal with precipitated iron oxide and conveniently with alkaline reacting substances.
8964	7/23/35	Germ 695,211 Fr 809,398 Brit 467,117	Coal saturated with a sulfuric acid solution of crude sulfide molybdenum ore, or molybdenum sulfide, prepared by the working-up of the residue of earlier operations of coal hydrogenation.
9109 10,560	11/21/35	Germ 694,293 Fr 812,218	Calcium sulfate or aluminate used as a catalyst in the pressure hydrogenation of coal.
9110	11/21/35	Germ 707,531 Fr 814,334 Brit 466,609 US 2,170,976	Pressure hydrogenation using swelled fuller's earth as a catalyst or a carrier.
9124 9278	11/28/35	Fr 813,460 Brit 466,284	Treating tin-containing materials with tars, mineral oils, or coal hydrogenation products at elevated

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9124 9278				temperature and pressure hydrogenating the oils containing tin in the dissolved state.
9179	1/4/36	Germ Fr	695,993 809,403	Pressure hydrogenation of coal to heavy oil in the presence of organic zinc or tin compounds or of zinc or tin ammonium chlorides.
9222	2/1/36	Germ Fr	698,006 816,955	Zinc compounds of low molecular weight mono-basic carboxylic acid, if necessary with halogens, to be used as catalysts in the pressure hydrogenation.
9278		Germ	703,836	See O.Z. 9124
9299	3/19/36	Germ Fr	698,968 818,742	High boiling pressure hydrogenation products or residues are used after addition of halogen-free ammonium or alkali salts for pasting oil for fresh coal.
9336	4/16/36	Germ Fr	695,274 820,633	Coking product of the pressure extract as a catalyst or a carrier.
9754	1/16/37	Fr Brit	834,541 493,947	Only the coarser particles of the catalysts are removed from the reaction products obtained in the return of the catalysts; these products replaced by fresh catalysts.
10152	8/5/37	Fr	841,029	The use of catalysts of stream-lined shape.
10380		Germ	678,622	See O.Z. 5102
10391	12/11/37	Germ	711,470	Addition of sulfur from time to time in presence of heavy metal sulfides to the pressure hydrogenation.
10560		Germ	695,276	See O.Z. 9109
10870		Germ	686,456	See O.Z. 6935
10917 10918 10919		Germ Germ Germ	717,189 695,524 677,462	) See O.Z. 7493)

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11338	2/3/39	Germ Fr	740,309 888,605	Catalysts prepared by long treating of fuller's earth, active silica or alumina with metal salt solutions at elevated temperatures. Drying and heating above 450°C.
11348	2/8/39	Fr	888,246	Catalysts consisting of fuller's earth saturated with solutions of salts of metals of the II to VIII groups and then washed out.
11658	7/13/39	Germ Fr	736,093 890,187	Solutions of molybdenum or tungsten sulfide or oxide in nitrogen-containing cyclic hydrocarbons saturated with hydrogen and treated with hydrogen sulfide. The precipitated compounds are added to sulfides and used as catalysts in the pressure hydrogenation.
11729	8/14/39			Preparation of highly active catalysts by shaping finely ground coal with viscous or solid fusible carbon-containing substances and heating sufficiently high finely pored catalysts to obtain great mechanical strength after complete or partial elimination of gas or tar-forming constituents; activated with vapors or gases at high temperatures.
11869	11/18/39	Germ Fr	736,409 889,107	The amounts by volume of the catalysts passing through the reaction space is at least four times as large as the amounts by volume of the raw materials passing in the same time.
12632	3/11/41			Pressure hydrogenation catalysts consisting of Cr_2O_3 + 0.5 - 20% of molybdenum compounds, if necessary compounds of Li, Mg, Zn, Zr, Ce, or the rare earths.

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12677	3/27/41		Active alumina with small amounts ~~of silica or silicate as a catalyst~~ carrier for pressure hydrogenating catalysts.
12678	3/27/41		Alumina saturated with molybdemum compounds and very slowly heated to above 300°C to be used as pressure hydrogenation catalysts.
12694	4/4/41	Germ 752,827	Preparation of active alumina by the precipitation of aluminum hydroxide from a solution of aluminum salt at temperatures above 80°C and a pH between 7 and 10.
12807	5/30/41		Fuller's earth or artificial silicates, the acidity of which is reduced by the addition of oxides of Mg, Zn, Be, or the rare earths to be used as catalysts in the pressure hydrogenation of heavy gasoline or middle oils.
12916	7/26/41		Preparation of active alumina by precipitation at above 80°C and a pH between 7 and 10 from aluminum sulfate or sulfite, and after treatment with NH_3 at raised temperatures.
12986	9/13/41		Cr_2O_3 + 60 - 140% of tungsten compounds to be used as catalysts in the pressure hydrogenation.
13043	10/15/41		Preparation of solid shaped catalysts from finely ground materials by grinding part of these materials to colloidal fineness, mixing them moist with other less finely ground materials, shaping the mixture and heating.
14062	3/12/43		Catalysts for the pressure hydrogenation consisting of natural or artificial silicates which contain active silica.

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14110	3/29/43		Preparation of active alumina by the precipitation of $Al(OH)_3$ from solutions of aluminum nitrate with solutions of alkalies in the presence of water soluble compounds of divalent metals. Drying, shaping and heating to 300 - 600°C.
14810	6/18/44		Splitting dehydrogenation or cyclization with hydrogen under pressure using catalysts of different grain size, with the starting materials coming in contact first with the coarsest, than with the finest catalyst grains.
14986	10/20/44		Heating of active alumina with carbon monoxide to 300 - 600°C, preferably at increased pressures.

b) Catalysts: Halogens and Acids

3700	8/7/26	Germ 677,104	Pressure hydrogenation in the presence of halogens, hydrogen halides or metal halides.
8837		Fr 733,972	
8838		Fr 616,237	
8839		Brit 275,664	
		Brit 299,020	
		Brit 299,021	
		US 1,938,542	
7384	12/28/31	Germ 722,405	The use of halogen compounds, e.g. organic chlorine compounds, containing solid non-metals (P,S,Se,Te,Si) as catalysts in the pressure hydrogenation.
8103		Fr 746,496	
8530		Brit 406,006	
		Brit 407,034	
		US 2,118,940	
7397	1/7/32	Germ 704,564	Dehydrogenation with halogens or halides as catalysts.
		Fr 748,442	
		Brit 409,312	
7398	1/2/32	Germ 646,405	Pressure hydrogenation in the liquid phase in the presence of halides of Ag, Cu, Cd, Ti, Sn, V, Mo, W, Mn, Ni, or Co.
		Fr 747,459	
		Brit 403,481	
		Brit 405,736	
		Brit 406,963	

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7398		US 2,028,348 US 2,098,400 US 2,087,608	
7400	1/7/32	Germ 642,741 Fr 747,459 Brit 403,481 Brit 405,736 Brit 406,962 US 2,028,348 US 2,098,400 US 2,087,608	Pressure hydrogenation in the vapor phase with the catalysts mentioned under O. Z. 7398.
8103		Germ 678,808	See O. Z. 7384
8136	11/10/33	Fr 780,826 Brit 431,519 US 2,068,868	Pressure hydrogenation in the presence of acid substances corroding the walls of the containers, and with the addition of arsenic compounds, cyanides of heavy or alkaline earth metals or of organic nitrogen bases.
8162	11/21/33	Germ 680,327 Fr 781,578 Brit 432,489	Neutralization of the basic constituents of coal. Hydrogenating the coal under pressure after the addition of acid reacting substances.
8170 10864	11/24/33	Germ 695,209 Fr 779,872 Brit 438,084	Pressure hydrogenation in presence of metal halides together with halogen or hydrogen halide (tin halide, tin ammonium chloride).
8231	1/10/34	Germ 709,940 Fr 785,245 Brit 439,265	Pressure hydrogenation in the presence of solid carbonaceous adsorbents, pretreated with halogen or hydrogen halides. Pressure hydrogenation of coal pretreated with halogen.
8303 10818 10820 10822	3/10/34	Germ 696,082 Fr 786,937 Brit 442,440 US 2,100,354	Pressure hydrogenation in the presence of finely dispersed metals with the addition of halogen, hydrogen halides or halogen compounds. Halogen or hydrogen halide is split off during the reaction.

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8331	3/31/34	Germ	699,492	Use of less than 2% of hydrogen halide in operations according to O. Z. 8303
~~10819~~		~~Fr~~	~~786,937~~	
10821		Brit	442,440	
10823		US	2,100,354	
8357	4/21/34	Germ	639,842	Preventing the decomposition of non-metal compounds before they come in contact with the feed, these compounds being added during or after preheating.
		Fr	787,520	
8447	7/7/34	Germ	669,660	The reaction products containing acid materials in the gas or vapor state are brought in contact with the liquid raw materials containing alkaline substances.
		Fr	791,699	
		Brit	443,133	
8487	7/31/34	Germ	677,206	Lead or lead compounds with halogen or hydrogen halides used as catalysts.
		Fr	793,464	
		Brit	457,211	
8530		Germ	678,808	See O. Z. 7384
8534	9/4/34	Germ	695,269	The use of manganese or metals of the iron group or their compounds as catalysts together with alkaline acting materials and halogen or compounds splitting off halogen.
		Fr	795,349	
		Brit	450,473	
		US	2,119,647	
8535	9/11/34	Germ	646,477	Germanium and its compounds + halogen or hydrogen halide and/or alkaline substances used as catalysts.
		Fr	794,437	
		Brit	446,114	
8553	9/25/34	Fr	793,799	Lead or its compounds and acid reacting substances used as catalysts.
8555	9/25/34	Germ	692,631	Pressure hydrogenation in presence of halogens and with the addition of halogen combining materials towards the end of the reaction
		Fr	795,375	
		Brit	447,210	
8695	12/29/34	Germ	659,925	Pressure hydrogenation with catalysts or catalyst carriers (fuller's earth) pretreated with fluorine or hydrogen fluoride.
		Fr	800,971	
		Fr	800,972	
		Brit	452,158	
		Brit	452,095	

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8695		US 2,154,527 US 2,194,186	
8837		Germ 650,088	See O. Z. 3700
8838		Germ 671,183	See O. Z. 3700
8839		Germ 654,024	See O. Z. 3700
9174	12/24/35	Germ 695,992 Fr 807,929	Pressure hydrogenation in presence of halogen, hydrogen halide or non-metallic halogen compounds and metals (Fe, Zn, Sn) in such limited amounts that no lumping together will take place in the reaction vessel.
9212	1/30/36	Germ 695,994	Pressure hydrogenation in presence of lead formate or acetate + halogen or hydrogen halide.
9228	2/6/36	Fr 816,885 Brit 469,158 US 2,177,376	Asphaltic substances in presence of halogen, hydrogen halide or non-metal halides hydrogenated under pressure.
10020	6/3/37	Germ 704,231	Washing out halogen or halogen compounds from the reaction products of the reaction vessel and catchpot with halogen-combining materials in a vessel provided with insets.
10541	2/14/38	Germ 763,555	Dehydrogenation with halogen in presence of catalysts or with filling materials.
10750	2/15/37	Germ 699,824	Pressure hydrogenating of primary bitumen using as catalysts halogen compounds of the heavy metals dissolved in phenols.
10818		Germ 695,996	See O. Z. 8303
10819		Germ 699,424	See O. Z. 8331
10820		Germ 695,277	See O. Z. 8303
10821		Germ 699,609	See O. Z. 8331

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10822		Germ 696,809	See O. Z. 8303
10823		Germ 701,513	See O. Z. 8331
10864		Germ 697,949	See O. Z. 8170
11070		US 2,041,858	Pressure hydrogenation with nascent hydrogen generated during the reaction from iron and water, in the presence of chlorides of magnesium iron, chromium, nickel, manganese.
14549	1/10/44		Improvement of knock-rating properties of gasolines by isomerizing pressure hydrogenation of middle oil and heavy gasoline in the liquid phase with metal halides including BF_3 + activated charcoal or active alumina + hydrogen halide + hydrogen and/or hydrocarbon -containing gases.
14808	6/19/44		Preparation of strongly branched paraffinic hydrocarbons from naphthenic hydrocarbons by treatment with hydrogen and hydrogen halide at 50 - 100°C under a pressure of 30 - 200 atm in the presence of aluminum chloride.
c) Catalysts: Iron-Tungsten			
9136	12/5/35	Brit 448,651	Reduction of phenols, dehydrogenation and demethylation with weakly hydrogenating sulfides together with a smaller amount of stronger hydrogenating sulfides as catalysts.
9675	11/30/36	Brit 448,651 US 2,227,672	Pressure hydrogenation using sulfides of moderate hydrogenating action with somewhat smaller amounts of stronger hydrogenating sulfides.
9898	4/3/37	US 2,227,672	Pressure hydrogenation in the presence of weakly hydrogenating

The I. G. Serial Number O. Z.	Date	Patent	
9898			metal sulfides with a smaller amount of stronger hydrogenating metal oxides.
9920	4/14/37	Germ 696,364 US 2,227,672	Pressure hydrogenation of asphaltic materials with a catalyst described in O. Z. 9675.
9982	2/24/37	US 2,227,672	Pressure hydrogenation with weakly hydrogenating sulfides with smaller amounts of stronger hydrogenating sulfides as catalysts.
9983	3/12/37	US 2,227,672	Splitting pressure hydrogenation in the presence of sulfide mixtures upon a carrier. Pretreatment or after treatment with sulfide mixture without a carrier.
10125	7/26/37	US 2,227,672	Refining pressure hydrogenation with sulfide mixtures.
10161	8/12/37	US 2,227,672	Preparation of sulfide mixtures by conversion of mixtures of the corresponding metal compounds.
10162	8/12/37	US 2,227,672	Saturating a weakly hydrogenating sulfide with a solution of a stronger hydrogenating metal compound.
10256	2/12/37	US 2,227,672	Production of aromatic hydrocarbons using selective solvents from raw materials produced by thermal treatment with sulfide mixtures.
10907	7/16/38	Germ 716,959 US 2,238,851	Heating ammonium sulfo salts of the metals of the VI group with salts of metals of the iron groups to above 300°C until the evolution of NH_3 becomes weaker. The use of sulfide mixtures as catalysts.
12029	8/10/38		Diisobutylene hydrogenation in the presence of sulfide mixtures of nickel and tungsten.

The I. G. Serial Number O. Z.	Date	Patent		
12088	4/5/40	Germ	766,150	Addition of ammonium sulfide to aqueous solutions of iron salts, washing the precipitate, or making the ammonium salts harmless by the addition of oxides or hydroxides of polyvalent metals which form salts stable up to at least 500°C with the acid residues of the ammonium salts, mixing the precipitate with ammonium sulfo salts which contain metals of the VI group in the acid radical. Heating the mixture to temperatures over 300°C and shaping the catalysts.
12089	4/5/40	Germ	725,604	Metal sulfides prepared by heating over 300°C the mixtures prepared in the dry way of ammonium sulfo salts containing metals of the VI group in the acid radical and of finely divided metals prepared from carbonyls of the metals of the iron group.
12129	5/3/40			Production of anti-knock gasolines from hydrocarbon mixtures with high naphthene contents by dehydrogenation with nickel-tungsten sulfide catalysts. Preparation of the hydrogen-rich fractions with selective solvents and aromatization of these fractions.
d). Catalysts: Synthetic Silicates				
7573	7/28/25	Germ	617,593	Preparation of catalytically active masses by mixing of colloidal carriers in the form of gels with catalytically active inorganic substances using vigorous mechanical treatment to the production of a homogenesis mass.
10157	8/9/37	Germ Fr Brit	739,510 841,898 504,614	Catalysts from several substances obtained by mixing of gel-like materials with a salt of metals in the presence of the precipitating agent.

The I. G. Serial Number O. Z.	Date.	Patent		
10167 12967	8/13/37	Fr Brit	841,898 504,614	Preparation of catalysts from several substances for the splitting pressure hydrogenation by mixing of a gel in a moist state with a solution of metal salt, followed by heating.
10578	2/26/38	Germ Fr Brit	745,634 841,898 504,614	Catalysts consisting of several substances obtained by mixing of gel-like materials with a solution of magnesium salt followed by a simultaneous precipitation.
10579	2/28/38	Germ Fr Brit	711,316 841,898 504,614	Catalysts obtained by precipitation of a solution of water glass, preferably previously acidified, using metal salt solution, if necessary a complete or partial leaching out of the metals.
10760	5/9/38	Fr Brit	841,898 504,614	Mixing of solutions of a gel forming material with metal salt solutions without causing any precipitation. Subsequent addition of a precipitating agent. Leaching with acids the metals from the catalysts.
10915	7/20/38	Fr Brit	841,898 504,614	Complete or partial leaching of metals from catalysts composed of several substances (O.Z. 10157).
11056 12390	9/28/38	Germ	730,291	Catalysts prepared by mixing a moist gel, or a solution of a gel forming material with water solutions of metal salts and a precipitating agent. Drying the mass. Heating to 250 to 800°C and adding metal sulfides. The addition of metal sulfides can be omitted in pressure hydrogenation under 350 - 800 atm.
11077	10/11/38	Germ Fr Brit	711,317 841,898 504,614	Catalysts prepared by mixing of solutions of gel forming substances with solutions of metal salts, gelled by heating.

The I.G. Serial Number O.Z.	Date	Patent		
11078	10/11/38	Fr Brit	841,898 504,614	Preparation of catalysts by the introduction of a solution of a gel-forming substance into a solution of a metal salt under such conditions that gels are immediately formed upon contact.
11079	10/11/38	Germ Fr Brit	741,494 841,898 504,614	Catalysts prepared by mixing of a solution of a gel-forming substance with a solution of metal salts under such conditions that an excess of acid be present in the mixture and gel would only form after a longer standing. Leaching out of the metals from the finished mass.
11081 11226 11252	10/11/38	Fr	841,898	Catalysts consisting of SiO_2 and one or more metal compounds produced from a silica gel-forming sol at the pH between 3 and 7.
11119	5/11/38			Catalysts prepared by mixing of a silica sol or water-containing silica gel with magnesium compounds + a precipitating agent. Drying of the mass and addition of compounds of metals of the V or VI group and heating to high temperatures.
11167	12/1/38	Germ	764,247	Catalysts with the total active pore volume consisting between 60 and 85% of pores with a diameter between 0 and 2 μ μ.
11194	12/9/38	Germ	742,065	Catalysts prepared by pouring a solution of a gel forming substance and a solution of metal salts into a solution of precipitating agents. Heating the precipitated mass and adding the metal compounds.
11196	12/10/38	Germ Fr	764,405 893,035	Catalysts prepared from water glass, free from compounds of alkali metals and containing compounds of one or more of other metals.

The I.G. Serial Number O.Z.	Date	Patent		
11212	12/17/38	Germ	739,592	Catalysts prepared by solution of natural aluminum silicates such as kaolin with alkalies or alkali carbonates, dissolving the alkali alumina silicates in acids. Production of a gel from the solution, washing, drying, and further heating of the solid gel.
11218	12/22/38	Germ	712,504	Catalysts or carriers from silica obtained from silicon halide and containing one or more metal compounds.
11219	12/22/38	Germ	736,932	Catalysts prepared by mixing a solution of water glass with a solution of aluminate. Solution of the precipitate formed in an acid. Production of a gel followed by heating.
11226	12/23/38	Fr Fr	841,898 51,051	See O.Z. 11081
11252	12/31/38	Fr Fr	841,898 51,051	See O.Z. 11081
11316	1/24/39			The use of porous, narrow-pore catalysts with a pH of 2.5 - 5 after heating to temperatures between 200 and 800°C.
11331	2/1/39	Germ	712,505	Catalysts prepared by mixing of calcium silicate with solutions of metal salts at elevated temperatures. Filtering, washing, drying and further heating.
11579	6/8/39	Germ	737,640	Catalysts consisting of silica gel after displacing the air in the pores with gases or vapor-forming water-soluble and readily condensible materials and saturating with metal salt solutions.
11623	6/28/39	Germ Fr	725,089 857,913	Preparation of narrow pore silica gel from silica gels with a pH below 6, which is dried in the usual way and becomes dispersed in contact

The I.G. Serial Number O.Z.	Date	Patent		
11623				with water, heated for so long at 500 - 900°C that it is converted into water stable gel without great reduction of its adsorption property, and treated with a metal salt solution.
11885	11/28/39	Germ Fr	764,445 889,108	Using catalysts containing Ba and Si compounds.
12108	7/4/39			Preparation of a catalyst by mixing of a solution of water glass with a metal salt under such conditions that an excess of acid be present in the mixture and a gel would only begin to form upon long standing.
12245	7/13/40	Germ Fr	752,698 887,320	A catalyst prepared by heating to at least 500°C in less than 1 hour a metal compound containing a silica gel.
12390				See O.Z. 11056
12753	5/8/41	Fr	888,651	Production of an alkali metal-free aluminum silicate by bringing together a solution of an aluminum salt and a solution of a divalent metal with a solution of water glass in such proportions that the alkali is practically completely combined with the acid radical of the salt and the mixture reacts alkaline.
12893	7/12/41			Catalysts prepared by mixing a silica gel dried to a water content of 20 - 40% with an also dried $Al(OH)_3$ or $Mg(OH)_2$. Grinding of the mixture followed by shaping.
12967				See O.Z. 10167
13428	5/14/42			Preparation of barium-containing natural or artificial aluminum and/or magnesium silicate for use as catalysts.

The I. G. Serial Number O.Z.	Date	Patent	
14775	6/2/44		Preparation of active silicon-containing catalysts carriers from water glass solution and ~~one or more metal salts in the~~ presence of HNO_3, separation of the gel from the liquid and heating to a higher temperature.
14782 14819	6/8/44		Synthetic silicates which contain compounds of metals of the II, III or of the VIII group so pretreated with fluorine that less fluorine is contained in the finished silicate than is equivalent to the metals of the II, III and/or VIII groups.
14984	10/19/44		Preparation of silicon-containing catalysts from water glass solutions + one or more metal salts + hydrofluoric acid. Separation of the precipitated gel and heating to higher temperatures.

e) Catalysts: Reactivation

5898	9/27/29	Fr 701,426 Brit 350,135 US 1,923,652 US 2,017,557	Production of molybdenum from spent catalysts by roasting of the material, treating with ammonia water or with acid and an oxidizing agent.
6403	5/2/30	Fr 40,133 Brit 350,135 US 1,952,459	Production of molybdenum by treating or roasting material with a solution of ammonia sulfide, containing free ammonia.
6964	2/17/31	Fr 41,415 Brit 375,948 US 1,944,420	Production of molybdenum by treating the dissolved material with a solution of ammonium carbonate containing ammonia or ammonium sulfide.
8086	9/16/33	Fr 778,221 Brit 424,916	Production of molybdenum from residues of the pressure hydrogenation by roasting with an excess of sulfuric acid and heating until molybdenum dissolves. Precipitation of molybdenum from the solution obtained using hydrogen sulfide at an elevated temperature.

The I.G. Serial Number O.Z.	Date	Patent	
8823	4/10/35	Germ 642,244 Fr 805,095 Brit 457,343 US 2,176,441	Working up of molybdenum or tungsten containing materials by volatilizing the hydrocarbon materials at high temperatures in an oxidising atmosphere and by treating with ammonia carbonate under pressure at elevated temperatures.
9009	8/17/35	Fr 810,101 Brit 458,699 US 2,157,332	Roasting catalysts, containing tungsten sulfide and treating the roast with an aqueous ammonia solution.
9442	6/27/36	Germ 657,873 US 2,191,794	Production of molybdenum from water solutions with lead sulfate in the presence of a small amount of excess sulfate ions.
10803	5/27/38	Germ 761,509	Reactivation of silica catalysts by a periodic addition of hydrogen. Increasing the hydrogen concentration, or passing hydrogen alone over the catalysts.
11179	12/6/38	Germ 739,269 Fr 889,485	Reactivation of shaped catalysts consisting of silicon-containing materials and metal sulfides by treating with oxygen-containing gases below about 500°C, than with sulfurizing agents.
11667	7/20/39	Germ 736,528	Preheated oxygen-containing gases are passed at such a rate through the layer of a catalyst that the heat generated will not cause a disturbing rise in the temperature of the catalysts which is being reactivated.
11965	1/20/40		Reactivation of catalysts with oxygen-containing gases and a cooling agent boiling above the reactivation temperature of the catalysts but below the reaction temperature.
12550	1/20/41	Fr 888,650	Reactivation of a catalyst used in reforming by heating it once or several times and re-using it. Then reactivation with oxygen-containing gases.

The I. G. Serial Number O.Z.	Date Patent	
13255	2/14/42	Reactivation of catalysts with gases containing increasing oxygen content in the superimposed zones of shaft furnaces.
13723	10/16/42	Reactivation of catalysts by heating in the presence of oxygen-containing gases with the temperature of the catalysts at the start of the reactivation kept lower than the ignition temperature of the coke-like deposit, while the temperature of the oxygen-containing gas is higher.
14797	6/13/44	Separation of alumina and compounds of the metals of the VI group by heating with sulfur or gaseous or vapor forming sulfur compounds, treating with hydrochloric or sulfuric acid and filtering.

II. Methods of Operation

a1) Vapor Phase b) Liquid Phase c) Pressure Range

The I. G. Serial Number O.Z.	Date	Patent	
3260	8/14/25	Germ 515,623 Fr 620,223 Brit 256,964 Brit 282,814 US 1,876,009 US 1,890,434 US 1,931,549 US 2,005,192 US 1,931,550 US 1,983,234 US 1,996,009 US 2,006,996 US 1,994,075	Pressure hydrogenation of coals, tars, mineral oils, with the addition of peat or brown coal.
3261	8/14/25	Fr 620,735 Brit 256,965 US 1,890,435	Pressure hydrogenation of coal, tar, and mineral oils in a finely dispersed state.
3276	9/2/25	Fr 620,735 US 1,876,009 US 1,890,434 US 1,931,549 US 2,005,192 US 1,931,550 US 1,983,234 US 1,996,009 US 2,006,996 US 1,994,075	Pressure hydrogenation of coal in the moist state or with the addition of water.
3421 3599	1/19/26	Fr 627,156 Brit 286,825 US 1,757,454	Hydrogenation or splitting in an electric arc.
3590	6/1/26	Fr 620,735 Brit 272,190 US 1,890,435	Pressure hydrogenation of coals, Tars, and mineral oils in thin layers.
3599	6/9/26	Fr 627,156 Brit 286,825 US 1,747,454	See O. Z. 3421
3605	6/11/26	Fr 620,735 Brit 272,539 US 1,890,435	Pressure hydrogenation of coals, tars, mineral oils with the addition of hydrogen through porous plates.

The I.G. Serial Number O.Z.	Date	Patent	
3618	6/14/26	Fr 620,735 Brit 272,556 US 1,890,435	Pressure hydrogenation of coals, tars, mineral oils, with large excess of hydrogen.
3635	6/25/26	Fr 620,735 US 1,890,435	Pressure hydrogenation of coals, tars, mineral oils, with occasional changes of the feed.
3636	6/26/26	Germ 614,916 Fr 620,735 Brit 273,337 US 1,890,435	Pressure hydrogenation of fractions of narrow boiling range, in particular middle oil.
4169	5/28/27	Germ 618,315 Fr 654,534 Brit 304,343 US 1,894,257	Pressure hydrogenation of coals, tars, mineral oils separation of the reaction products and return of the hydrogen-containing gases to the circuit without condensation.
4194	6/19/27	Germ 522,463 Fr 668,104	Pressure hydrogenation in the presence of wetting and emulsifying agents such as sulfonic acids.
4342	9/10/27	Fr 659,907 Brit 296,984	Production of anti-knock gasoline from a mixture of different partly liquid raw materials, using pressure hydrogenation.
4420	11/10/27	Brit 326,157 US 1,895,769	Pressure hydrogenation of coals, tars, mineral oils with the hydrogen introduced through orifices or several perforated plates for the purpose of a finer distribution.
4423	11/12/27	Fr 666,683 Brit 326,157 US 1,895,769	Conducting the liquid reaction products of pressure hydrogenation in a hot circuit to avoid local thickening.
4530	1/13/28	Fr 36,894 Fr 659,907 Brit 303,894	Production of anti-knock gasolines by pressure hydrogenation of mixtures of bituminous coal and brown coal.
4933	7/12/28	Germ 622,754	Pulsating motion of the gas in the reaction space.

The I.G. Serial Number O.Z.	Date	Patent	
5059	9/4/28	Germ 614,975 Fr ~~680,619~~ Brit 328,586 US 1,921,478	Prevention of settling of high molecular weight substances upon the catalysts by addition of high boiling aromatic oils.
5084	9/17/28	Germ 630,824 Fr 680,619 Brit 328,586 US 1,921,478	Pressure hydrogenation in the vapor phase, e.g. of middle oils, as well as the CO - H_2 synthesis in the presence of a liq uid non reacting medium.
5141	10/15/28	Fr 37,394 Fr 666,683 Brit 326,184 Brit 328,992 US 1,932,673	Pressure hydrogenation in the liquid phase with the catalyst uniformly finely distributed through the liquid.
5187	11/7/28	Fr 684,181	Pressure hydrogenation combined with ammonia and methanol synthesis.
5767	7/31/29	Germ 585,652 Fr 698,244 Brit 358,926 US 1,960,972	Permitting a free fall of the feed through the high pressure space provided with heating units.
5839	8/27/29	Fr 700,891 Brit 354,181 US 1,960,794	High partial pressure of the products of pressure hydrogenation formed in the vapor phase.
5998	11/25/29	Fr 704,476 Brit 349,588 US 1,937,554	Pressure hydrogenation of tars, mineral oils or cracking residues, pitches etc with polynuclear hydrogenated aromatic hydrocarbons used as thinners.
6136	1/24/30	Germ 616,427 Fr 39,626 Fr 666,683 Brit 359,993 US 1,963,759	Maintenance of the suspended state of the catalysts in the pressure hydrogenation in the liquid phase by the elimination of flocculating materials.
6278	11/1/28	Germ 669,049	Pressure hydrogenation under such conditions that the required hydrogen is dissolved in the feed.
6541	7/1/30	Fr 717,566 Brit 367,776	De-asphaltising of the pasting oil for coal.

The I.G. Serial Number O.Z.	Date	Patent		
6575	7/18/30	Germ Fr	568,544 721,718	Pressure hydrogenation of liquid feed containing larger amounts of unsaturated aliphatic compounds, after addition of aromatic or saturated aliphatic hydrocarbons.
6683	9/5/30	Fr	721,718	Production of gaseous hydrocarbons by pressure hydrogenation of gasoline and middle oils with splitting catalysts above 400°C.
7295	10/23/31	Fr	742,843	Pressure hydrogenation of dry coal with the addition of minor amounts of liquid hydrocarbons, preferably high boiling.
8031	7/22/33	Fr	767,201	Reducing the amount of the fraction of the reaction products boiling below 100°C by increasing the thruput of the feed (minimum 2 kg per liter catalysts space per hour).
8110	10/28/33	Fr Brit	779,912 430,655	Regulating the boiling point curve of the reaction products by the addition of the feed in one or more parts of the converter.
8727	4/21/28	Germ	623,001	Pressure hydrogenation of tars and mineral oils, which can be reduced with the formation of water, with non reducible metal oxide compounds used as catalysts.
9138	12/6/35	Germ Fr	672,611 812,219	Mixing a catalyst dissolved and suspended in a liquid with coal of such moisture content which will permit the maximum lift by suction.
9187	1/15/36	Germ Fr Brit	713,809 812,220 472,354	Pasting coal with middle oil in the pressure hydrogenation and returning one part of the HOLD from the catchpot to the preheater or the converter.
9274	3/3/36	Fr	819,896	Pressure hydrogenation of coal at a pressure determined by preliminary tests, above which no additional oil is formed, or at a higher pressure.

The I.G. Serial Number O.Z.	Date	Patent	
9366	5/14/36	Fr 821,792	Pressure hydrogenation of middle oils above 300 atm with a very active hydrogenation catalysts, in particular with sulfides deposited upon carriers.
9397	5/30/36	Fr 822,306 US 2,227,671	Pressure hydrogenation of asphaltic oils with fixed bed catalysts at a pressure above 300 atm determined by preliminary tests.
9441	6/27/36	Germ 695,212	Splitting pressure hydrogenation of purified coal middle oils which still contain small amounts of impurities.
9496	7/21/36	Germ 725,740 Fr 824,232	Production of gaseous hydrocarbons by pressure hydrogenation of liquid hydrocarbons in the presence of sulfides deposited upon carriers.
9535	8/17/36	Germ 720,824	Pressure hydrogenation of coal paste at temperatures below 415°C over fixed bed catalysts.
9539	8/17/36	US 2,206,729	Substances used for thinning out, containing liquid or semi-solid hydrocarbons, to be used with middle oils of such hydrogen content that no flocculation will result, with the use in the first stages of low-hydrogen cyclic thinners and in the following stages thinners containing more hydrogen.
9718	12/24/36	Brit 488,513 US 2,206,729	Pressure hydrogenation of brown coal tars, mixing the fractions boiling above diesel oils with the fresh feed, separating asphalts and pressure hydrogenating the mixtures.
9720	12/28/36	Germ 695,213 Brit 488,513 US 2,206,729	Pressure hydrogenation of brown coal tars, the addition of fractions boiling above diesel oils to the reaction space only after a preliminary prehydrogenation of the asphalts of the feed.

The I.G. Serial Number O.Z.	Date	Patent	
9721	12/28/35	Germ 702,902 US 2,165,940	Improvement of fuel oil by the addition of less than 1% hydrogen.
10081	7/3/37	Germ 755,753 Fr 840,124 Brit 500,366	Moving the catalysts through the reaction space and raising the temperature to maintain the same degree of conversion.
10092	7/10/37	Germ 702,183	Pressure hydrogenation of high-hydrogen middle oils with hydrogen and a larger volume of gaseous hydrocarbons.
10124	7/26/37	Germ 710,273 Fr 840,557	Lowering the reaction temperature with the progress of the reaction of pressure hydrogenating of asphaltic materials.
10208	9/9/37	Fr 841,497	A pasting oil consisting of a catchpot heavy oil and an oil obtained by distillation of the HOLD to pitch or coke.
10521	2/7/38	Germ 725,602	Oxygen-rich coals pressure hydrogenated with hydrogen + carbon monoxide at above 400 atm, with the partial pressure of carbon monoxide at least 100 atm and of hydrogen at least 200 atm at the beginning of the reaction.
10562	2/19/38	Germ 727,624	Production of middle oils from asphalt-containing heavy oils by pressure hydrogenation 450 - 550°C with weakly hydrogenating catalysts and high thruputs under pressures exceeded 250 atm, so that the propane asphalt content is reduced to less than 6%, and a formation of 30 - 70% of a fraction boiling below 350°C.
10584	3/2/38	Germ 712,254 Fr 850,809 Brit 531,543	The addition of gaseous olefins during the pressure hydrogenation or pressure extraction.
10650	4/1/38	Germ 711,348 Fr 852,269 Brit 524,380 US 2,224,003	Pressure hydrogenation of high-hydrogen hydrocarbons with very active catalysts, the activity of which had been previously reduced by the pressure hydrogenation of hydrogen-poorer hydrocarbons.

The I.G. Serial Number O.Z.	Date	Patent	
10743	10/3/28	US 1,936,819	Liquid and/or solid hydrocarbon-containing material is made to react with finely ground metal and water at a minimum of 380°C under the pressure of 200 atm produced spontaneously.
10744	3/6/39	US 2,057,996	A reduction of the phenols with iron and water at 400 - 500°C under pressures of 50 - 300 atm.
10758	5/8/38	Fr 854,502 US 2,228,118	Splitting kogasin and hydrogen-poor hydrocarbons with hydrogen above 350 atm.
10804	3/20/33	Fr 770,429 Brit 435,457 US 2,088,214	Pressure hydrogenation with nascent hydrogen produced during the reaction between metal and water. Draining the products into a catchpot and returning the metal.
10830	8/30/37	Fr 841,528 Brit 505,953 US 2,232,673	Decomposing tars by mixing with kogasin into two parts of unequal gravity and subjecting the lighter part with the kogasin to hydrogenation in the vapor phase, the heavier part to hydrogenation in the liquid phase.
11071		US 2,012,318	Pressure hydrogenation with nascent hydrogen, heating powdered zinc with water 300 - 500°C in closed vessels, reducing the zinc oxide in the residues with the gaseous products of the reaction and heating, which will cause metallic zinc to volatilize. Molybdenum catalysts used.
11072		US 2,057,971	Pressure hydrogenation of carbon-containing substances by heating in closed vessels with water and finely powdered metal to temperatures above the critical temperatures of water. The water is heated above its critical temperature at above its critical pressure outside of the conversion zone.

The I.G. Serial Number O.Z.	Date	Patent		
11272	1/9/39	Germ	708,308	See O.Z. 9535
11420	3/14/39	Germ	730,049	Introducing gaseous or light boiling hydrocarbons towards the end or behind the converter or in the catchpot.
12201	6/19/40	Germ Fr	741,224 893,492	Pressure hydrogenation of middle oils and heavy gasoline raising the end boiling point of the gasoline separated from the reaction products gradually by 10 - 40°C until the replacement or reactivation of the catalysts, depending of the reduced activity of the catalysts.
12602	1/10/43			Production of coal paste for pressure hydrogenation using the heavy oil obtained in the pressure hydrogenation of coal as pasting oil, pressure released in such a way that the heavy oil escapes in the form of vapors and pitch remains with the formation of a maximum 15% of a fraction boiling below 350°C.
13114	11/22/41			Coal + middle oil + HOLD pressure hydrogenated with less hydrogen above 450°C and 300 atm with the formation of a filterable HOLD.
13143	12/6/41	Fr	888,510	Pressure hydrogenation in presence of weakly hydrogenating catalysts above 1,000 atm.
13365	4/4/42	Fr	892,979	The use of dust-containing tars together with the asphaltic residues as pasting oil for coal.
13555	7/16/34			Coal + middle oil + HOLD pressure hydrogenated with more than 1 cbm hydrogen per kg coal.
13988	2/11/43			Pressure hydrogenation of coal without pasting media, separation of the solids from the gases and vapors without lowering the temperature.

The I. G. Serial Number O.Z.	Date	Patent	
14280	7/6/43		Production of an ash-free bitumen from oil shale by heating in closed vessels oil shale concentrate containing at least 50% organic materials if necessary with hydrogen under pressure, for at least 3 hours to about 360 - 425°C in the presence of a solvent, and filtration while warm.
14401	1/10/43		The use of the residue formed during the pressure hydrogenation of coal or of the heavy oil-containing residue as pasting oil for coal.
14600	2/19/44		Maintain a lower flow rate in the first converter during pressure hydrogenation then in at least one of the following converters.

a2) Aromatization

3464 3499 3617 3847	2/26/26	Fr 629,838 Brit 293,887 Brit 293,906 US 1,913,940 US 1,913,941	The preparation of aromatic hydrocarbons by an aromatizing pressure hydrogenation at over 500°C of coal, tar, oil, cracking or pressure hydrogenation products, naphthenes or cyclo paraffins in presence of dehydrogenating catalysts, e.g. oxides of the metals of the VI group alone, mixed, or with other active materials, in particular with oxides of the III and IV groups with or without carriers; or with activated charcoal alone or with other compounds, in particular those of the metals of the VI group. The hydrogen is re-circulated, preferably after a removal of gaseous hydrocarbons formed, such as methane.
3499	3/22/26	Germ 626,273 Fr 629,838 Brit 293,887 Brit 293,906 US 1,913,940 US 1,913,941	See O.Z. 3464

The I.G. Serial Number O.Z.	Date	Patent		
3617	6/14/26	Fr	629,818	See O.Z. 3464
		Brit	302,253	
3847	11/24/26	Fr	629,818	See O.Z. 3464
		Brit	281,298	
6082	1/2/30	Fr	706,767	Aromatizing pressure hydrogenation of the gasoline fractions.
		Brit	354,181	
		US	1,960,794	
7122	6/11/31	Fr	738,368	Pressure hydrogenation at 400 - 450°C under strongly hydrogenating conditions with a partial pressure of the hydrogenating products less than 10%, and followed by aromatizing pressure hydrogenation at a partial pressure of the products formed exceeding 10%.
7152	7/16/31	Germ	624,844	Converting hydrogen-rich middle oils or high boiling oils by aromatizing pressure hydrogenation into products containing cyclic hydrocarbons, pressure hydrogenating them into low boiling cyclic products saturated with hydrogen and followed by dehydrogenation.
		Fr	739,988	
		US	2,045,795	
7301	10/30/31	Germ	636,385	Reduction of phenols to aromatic hydrocarbons by catalytic pressure hydrogenation.
		Fr	743,570	
		Brit	397,901	
7757	11/12/32	Fr	763,575	Aromatizing pressure hydrogenation of middle oils and gasolines in the liquid phase with the addition of finely subdivided catalysts.
		Brit	416,976	
8116	10/25/33	Fr	779,914	Refining heavy gasolines, followed by aromatizing pressure hydrogenation.
		Brit	431,683	
8421	6/22/34	Germ	689,241	Pressure hydrogenation to gasoline with at least 10% fraction boiling over 200°C of liquid hydrocarbons in particular coal middle oil with a high content of cyclic hydrocarbons, aromatizing pressure hydrogenation of the fraction boiling over 200°C, blending the gasolines obtained in the two steps.
		Fr	790,809	
		Brit	442,385	

The I.G. Serial Number O.Z.	Date	Patent		
8591	10/19/34	Germ Fr Brit	654,333 796,443 452,429	Decomposing middle oils into a light and a heavy fraction. Pressure hydrogenating the lighter fraction first under mild conditions, then under aromatizing conditions, splitting pressure hydrogenation of the heavy fraction.
9113	11/22/35	Fr Brit	815,928 472,691	Pressure hydrogenatón of middle oils at moderately elevated temperatures. Separation of gasoline, aromatizing pressure hydrogenation of the residues.
9178	1/3/36	Germ Fr Brit	695,386 827,399 482,431	Obtaining benzol and toluol from coal by pressure hydrogenation, separation of the middle oil fraction and separating it into two parts: the high boiling fraction is converted to a hydrogen-rich gasoline under strongly hydrogenating conditions, and that gasoline is pressure hydrogenated with sulfides or oxides of the metals of the V and/or VI groups. The low boiling fractions are dephenolated and aromatizingly pressure hydrogenated.
11328	1/31/39			Aromatization in presence of a catalyst consisting of 70 - 95% Cr_2O_3 and 30 -5% of V_2O_5.
11694	8/1/39	Germ	765,440	Aromatizing pressure hydrogenation of hydrogen-poor middle oils in the vapor phase to form 20 - 50% gasolines, splitting hydrogenation of the fraction separated above the boiling range of the gasoline in the presence of strongly hydrogenating heavy metal compounds upon fullers' earth.
12162	5/25/40	Germ Fr	745,558 886,342	Aromatizing pressure hydrogenatón of middle oils, separation of the reaction products into gasoline and middle oils in such a way that their Engler boiling point curves do not intersect.

The I.G. Serial Number O.Z.	Date	Patent	
13318	3/18/42		The production of aromatic hydrocarbons by catalytic pressure hydrogenation of hydrogen-poor oils at above 500 atm. with the hydrogen-containing gas in the circuit having less than 0.05% by volume of hydrogen sulfide.
14248 14481	6/19/43		The production of low boiling aromatic hydrocarbons by catalytic pressure hydrogenation of mixtures of hydrocarbons boiling above 200°C, consisting predominantly of aromatic hydrocarbons and freed from oxygen and nitrogen compounds. The process is carried out in the vapor phase at 200 - 700 atm and 410 - 430°C in the presence of artificially prepared aluminum and/or magnesium silicates with 0.2 - 10% molybdic acid. The silicates may be completely or partially replaced with alumina or bauxite which has been pretreated with fluorine or with fluorides. The pressure hydrogenation may also be carried out in such a way that the oxygen compounds are reduced while the organic bases are removed with acids.
14426	10/12/43		The production of anti-knock gasolines from difficult-to-split aromatic middle oils by pressure hydrogenating in the first stage in the presence of oxides or sulfides of the metals of the II - VIII groups upon carriers having low splitting action, such as alumina, silicates, activated charcoal, at 480 - 550°C and 100 - 700 atm; and in the second stage in the presence of strongly splitting aluminum and/or magnesium silicates + the oxides or sulfides of the metals of the II - VIII groups at 350 - 500°C and 40 - 300 atm.

The I.G. Serial Number O.Z.	Date	Patent	
14436	10/22/43		The preparation of low boiling aromatic hydrocarbons, in particular of toluol, from higher boiling phenols or phenol-rich oils by pressure hydrogenating in two stages, with 20 - 300 atm at 350 - 450°C in the first stage, in the presence of alumina, magnesium oxide, zinc oxide with a small amount of molybdenum, chromium, tungsten or vanadium as catalysts; and in the second stage at 10 - 200 atm pressure at temperatures of 480 - 580°C and with the use of the same catalyst.
14481	11/29/43		See O.Z. 14248
a3) Dehydrogenation			
5356	1/19/29	Germ 578,567	Dehydrogenation with cobalt, or iron, or metals of the V - VII groups or their compounds pretreated with hydrogen sulfide, carbon by-sulfide or hydrogen selenide as catalysts.
7318	11/13/31	Germ 579,146 Fr 744,595 Brit 387,507 US 2,019,883	Dehydrogenation of heterocyclic compounds with metals of the VI group or their compounds.
7699	9/7/32	Fr 760,271 Brit 406,808	Dehydrogenation of hydro aromatics with catalysts consisting of metals which form difficultly reducible oxides, or their compounds, in particular metals of the VI group or their compounds.
7950 7952	5/5/33	Fr 772,811 Brit 443,001	The preparation of anti-knock gasolines by leading a mixture of gasoline vapors and hydrogen with a gasoline partial vapor pressure of 0.5 - 3 atm and a hydrogen pressure of 30 - 60 atm over sulfides or oxides of the metals of the V and/or VI group alone or mixed with oxides or sulfides or the heavy metals of the first and/or VIII groups, possibly with the addition of non reducible oxides, such as the oxide of Zr, Th, Ce.

The I.G. Serial Number O.Z.	Date	Patent		
8182	12/2/33	Fr Brit	782,201 435,254	Production of benzol hydrocarbons by dehydrogenation of pressure hydrogenation products, led together with a finely divided catalyst through the reaction space.
8449	7/10/34	Brit	435,254	Dehydrogenation of products of pressure hydrogenation by a silent electrical discharge.
8452	7/11/34	Germ Brit	699,305 435,254	Dehydrogenation of products of pressure hydrogenation in the presence of finely ground metals of the II, IV, or iron groups or their compounds with acid materials.
9220	2/1/36	Germ Fr Brit	695,273 817,152 472,538	Dehydrogenation of high boiling pressure hydrogenation products of bituminous substances and splitting the products obtained under pressure with small amounts of hydrogen with the production of benzol and its homologs.
9410	6/9/36	Brit	478,003	Dehydrogenation of saturated hydrocarbons at elevated temperatures in the presence of chromium oxide + alkali or alkaline earth halides.
9659	11/21/36	Germ	729,043	Dehydrogenation of the bituminous coal liquid phase gasoline.
9987	5/8/37	Germ	733,239	The production of a mixture of aromatic hydrocarbons rich in toluol, ethyl benzol and xylol by pressure hydrogenation of middle oils or heavy oils with strongly acting hydrogenating catalysts and dehydrogenation of the products obtained in the presence of hydrogen with sulfides or oxides of metals of the V and/or VI groups and conveniently of the first or VIII groups with a partial pressure of oil of 0.5 - 3 atm.

The I.G.

Serial Number O.Z.	Date	Patent		
10062	6/24/37	Fr Brit	838,010 502,961	Cyclization of aliphatic hydrocarbons by heating at 30 - 50 atm to high temperatures in presence of alumina with a small amount of a metal of the VI group or its compounds, possibly in the presence of hydrogen.
10210	9/10/37	Fr Brit	49,787 772,811	Production of safety fuels from pressure hydrogenation products boiling to 260°C by dehydrogenation at 30 - 60 atm hydrogen pressure and 0.5 - 5 atm partial pressure of the vapors, in the presence of sulfides or oxides of the metals of the V and/or VI groups and of the heavy metals of the first or VIII groups.
10616 11889	3/15/38	Germ Fr Brit	706,934 851,336 527,767	A re-arrangement of low boiling hydrocarbons by leading them under high pressures with hydrogen under low partial pressure over adsorbents or sulfides of the metals of the VI - VIII groups, or the difficulty reducible oxidic hydrogenation or dehydrogenation catalysts.
11578	6/8/39	Germ Fr	742,066 893,406	Production of anti-knock gasolines by leading refined hydrogen-rich gasolines in the vapor form + hydrogen with a gasoline vapor partial pressure of about 4 - 10 atm over oxides or sulfides of the metals of the V and VI groups + sulfides of the metals of the VIII group used as catalysts.
11889	3/15/38	Germ	708,622	See O.Z. 10616
12054	3/8/40			The production of anti-knock gasoline by leading over alumina + the oxides of chromium, molybdenum, tungsten, vanadium obtained by peptization with HNO_3.
12143	5/10/40			Dehydrogenation in presence of catalysts containing chromium compounds + active alumina, obtained from potassium compounds and such alumina which has not been made from aged $Al(OH)_3$.

The I.G. Serial Number O.Z.	Date	Patent	
12883	7/9/41		Dehydrogenation of hydrocarbons with alumina catalysts from non-aged $Al(OH)_3$ and aluminum powder, kept in motion.
13240	2/3/42		Dehydrogenation of hydrocarbons with re-pumping of larger amounts of the reaction products.
13636	9/2/42		Dehydrogenation of hydrocarbons with not aged $Al(OH)_3$, which contains no more alumina capable of swelling.
14183	5/20/43		Dehydrogenation or aromatization of hydrocarbons with the aid of compounds of chromium or alumina catalysts, containing alkali metals, prepared from peptizable alumina hydrate, and over a small amount of a non volatile inorganic acid.
14830	6/27/44		Dehydrogenation or aromatization over catalysts, containing active alumina, and the addition of small amounts of ammonia.
15033	12/11/44		Converting naphthenic pressure hydrogenation gasoline into anti-knock fuels by heating over 600°C in the presence of active alumina obtained by precipitation of solutions of alkali aluminates with acids at a pH above 7, washing out the alkalies, peptizing and heating to about 450°C.
15032	12/11/44		Converting naphthenic pressure hydrogenation gasolines into anti-knock fuels by heating to 600°C in the presence of active alumina prepared from aluminum hydroxide precipitated from aluminum salt solutions at a pH over 7 and at elevated temperatures.

a_4) DHD Process

11807, 12610	10/4/39	The splitting of aliphatic middle oils at 420-560°C in the vapor form with a small amount of hydrogen, at 3 -25 atm pressure,

The I.G. Serial Number O.Z.	Date	Patent	
11807 12610	10/4/39		and with a hydrogen partial pressure not exceeding one-half but at least equal to 25% of the total pressure, in presence of ~~oxides of the metals of the II-VI groups~~ deposited upon carriers, in particular alumina, and returning the hydrogen-containing residual gas in amounts of 0.3-1.5 or 2-4 cbm/kg feed.
11808 12608	10/4/39		Splitting of naphthenic middle oils at 440-550°C in the vapor form with a small amount of hydrogen at a pressure of 25-90 atm and a partial pressure of hydrogen of 30 - 50% of the total pressure, but below 30 atm, in the presence of fixed bed oxides of molybdenum, chromium or vanadium upon alumina, with the gases leaving the reaction space being returned without the addition of hydrogen in amounts of 0.3 - 1.5, or 2 - 4 cbm/kg. feed.
11888	12/1/39	Germ 737,021	The production of aromatic hydrocarbons from naphthenic gasolines in the vapor phase with a small amount of hydrogen at 20 - 75 atm and a hydrogen partial pressure composing 20 - 70% of the total pressure and lower than 30 atm, in the presence of fixed bed oxides of the metals of the II - VI groups upon carriers, and returning the gases leaving the reaction space back to the reaction space in amounts of 0.5 - 4 cbm/kg feed.
12180 12624 12625 12731	6/3/40		The production of anti-knock motor fuels by the pressure hydrogenation of high boiling hydrocarbons with a thruput of 2 - 4 kg/li catalysts/hr and at a temperature of 470 - 550°C of active alumina + the oxides of the metals of the V and VI groups, with a production of a middle oil which had absorbed a maximum of 2% hydrogen, followed by splitting pressure hydrogenation or splitting of the middle oil. The use of fuller's earth or artificially prepared silicates as carriers for the hydrogenation catalysts.

The I.G. Serial Number O.Z.	Date	Patent	
12188	6/5/40		Aromatizing pressure hydrogenation of middle oils to gasoline and reforming the latter at a pressure of 20-75 atm and a partial pressure of hydrogen below 40 atm, over alumina + compounds of the metals of the V and VI groups.
12207	6/20/40		The production of uniform aromatic hydrocarbons from DHD gasoline by treating naphthenic and/or aliphatic hydrocarbon mixtures with an end boiling point lying at most 25°C above the boiling point of the aromatic hydrocarbons to be made; the operations are carried in vapor form with hydrogen at 7-150 atm and 450-550°C in presence of the oxides of the V and VI group upon active alumina, followed by separation of the aromatics from the products of the reaction.
12260	7/20/40		The production of anti-knock motor fuels from olefinic gasolines which have been partially hydrogenated with hydrogen in the presence of hydrogenation catalysts, and then with hydrogen under pressure of 3-100 atm with a partial pressure of hydrogen of 20-70% of the total pressure, but below 50 atm, at above 460°C in the presence of oxides of chromium, tungsten, molybdenum or vanadium upon active alumina.
12440	11/16/40		Production of fuel oil with a specific gravity of over 1 for use upon ships, from high boiling oils following the DHD conditions.
12477 12478 14410	12/8/40		Hydrogen-poor middle oils containing hydrogen, oxygen compounds and/or olefins subjected to refining pressure hydrogenation at 15-70 atm with a partial pressure of hydrogen of 25-75% of total pressure, but below 35 atm, with a return of the hydrogen, in presence of alumina, magnesium oxide or zinc oxide + the oxides or sulfides of molybdenum, chromium, tungsten, vanadium + the oxides or sulfides

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12477 12478 14410	12/8/40		of the iron group (e.g. alumina-Mo-Ni) and if necessary strongly hydrogenating sulfides, then reforming or splitting hydrogenating in presence of heavy metal sulfides upon activated charcoal or HF-treated silica.
12500	12/16/40		Leading the reformed gasolines at 170 - 350°C with hydrogen over hydrogenation catalysts, and then over fuller's earth at below 270°C.
12533 12594	1/8/41		The production of active alumina by precipitating an aluminum salt solution with a basic magnesium compound. The addition of a salt solution of a catalytically active metal before or after heating.
12541	1/14/41		Refining gasoline and middle oil, or slightly hydrogenating the olefins with hydrogen at temperatures over 460°C in the presence of hydrogenating oxides of molybdenum, tungsten, chromium, vanadium. Next converting into anti-knock motor fuels at 15 - 75 atm and a partial pressure of hydrogen of 20 - 70% of the total pressure but below 40 atm, over oxides of molybdenum, chromium or vanadium upon active alumina, magnesia or zinc oxide.
12542	1/14/41		Conversion of gasoline and middle oil into anti-knock motor fuels by the DHD process at rising temperatures and under a pressure of 10 - 75 atm and a partial pressure of hydrogen below 30 atm.
12554	1/23/41		Blending of a DHD gasoline with a low-aromatic splitting or hydrogenation gasoline boiling below 130°C.
12594	2/24/41		See O.Z. 12533
12608	3/3/41		See O.Z. 11808
12610	3/4/41		See O.Z. 11807

The I.G. Serial Number O.Z.	Date	Patent	
12624	3/8/41		See O.Z. 12180
12625	3/8/41		See O.Z. 12180
12630	3/11/41		Treating hydrocarbon mixtures boiling between 80-380°C with selective solvents. Working up the extract by the DHD process.
12657	3/20/41		Gasoline and middle oil and heavy oil at 15-100 atm and partial pressure of hydrogen of 20-80% of the total pressure, but below 30 atm, and the return of 0.5-4 cbm hydrogen containing gas in the presence of oxides of molybdenum, tungsten, chromium, vanadium + compounds of Li, Mg, Be, Zn, Zr, Ti upon active alumina.
12718	4/19/41		The use as carrier for DHD catalyst of an alumina obtained by precipitation from aluminum salt solutions at temperatures over 80°C at a pH of 7-10 and heating.
12731	4/26/41		See O.Z. 12180
12743	5/5/41		Alumina, magnesium oxide, zinc oxide and so forth + oxides of molybdenum, tungsten, vanadium + alkali-free metal fluorides to be used as catalysts for the DHD process.
12746	5/6/41		Leading paraffinic or naphthenic gasolines over dehydrogenation catalysts, and next working them up to anti-knock motor fuels by the DHD process.
12769 12926 13627	5/16/41		Working up heavy oil or middle oil by the DHD process in the presence of alumina + metal fluorides, and if necessary of metal oxides to mostly middle oil which had absorbed up to 3% hydrogen, to be used as diesel oil or for pressure hydrogenation. The catalyst is to be used in a fixed bed or in the fluidized state.

The I.G. Serial Number OZ.	Date Patent	
12897 13679	7/16/41	Carrying out a DHD process with finely subdivided catalyst in the fluidized state.
12924	7/31/41	Reforming hydrocarbons by the DHD process in the presence of the catalyst consisting of a non-metal or ammonium fluoride+metal oxide upon catalyst.
12925	7/31/41	The return of preheated circulation gases in different parts during the DHD reaction.
12926	8/1/41	See O.Z. 12769
13285	3/7/42	The addition of olefins in several parts of the reaction space during the DHD process.
13485	6/10/42	Production of gasoline and middle oil by the DHD process in several stages with the pressure between at least 2 stages lowered by at least 5 atm.
13627	8/1/41	See O.Z. 12769
14123	4/3/43	Splitting pressure hydrogenation of high boiling DHD products in the presence of compounds of the heavy metals of the V - VIII groups upon active silicates.
14368	8/21/43	The production of low boiling uniform aromatic hydrocarbons by treating xylol and homologs in the vapor form with hydrogen in the presence of active alumina+a small amount of an oxide or fluoride of molybdenum, chromium or tungsten + about 30% SiO_2, or silicates of Al, Mg, Be, Zn at 480 - 550°C under DHD conditions at 10 - 50 atm.
14410	9/24/43	See O.Z. 12477

The I.G. Serial Number O.Z.	Date	Patent	
14431	10/16/43		Splitting pressure hydrogenation of high boiling DHD products over compounds of heavy metals of the V - VIII groups upon active silicates which are partially or completely replaced by alumina or bauxite and treated with fluorine or fluorine compounds, or to which alkali-free metal fluorides have been added.
14461	11/11/43		Refining the feed for the DHD process to a maximum sulfur content of 0.15% and suitably gaseous or vapor forming oxygen and/or nitrogen compounds of 0.5% or 0.1%.
14562	1/17/44		Reforming treatment of heavy gasoline, isomerization of the fraction 70 - 150°C and blending the products.

d) Multi-stage Processes

3105 8070	3/14/25	Fr 612,504 Brit 249,156 Brit 274,404 US 1,876,009 US 1,890,434 US 1,931,549 US 2,005,192 US 1,931,550 US 1,938,234 US 1,996,009 US 2,006,996 US 1,994,075	Pressure hydrogenation of coal followed by pressure hydrogenation of the tar obtained after the separation of ash.
3278	9/2/25	Germ 548,711 Fr 620,632 Brit 257,912 US 1,957,787	Increasing the value of coal in 2 stages, with the sulfur of the coal removed with steam in the first stage and pressure hydrogenation in the second stage.
4334	9/1/27	Fr 659,584 Brit 296,431 US 1,934,001	Pressure hydrogenation in several stages at decreasing pressures.

The I.G. Serial Number O.Z.	Date	Patent	
4444	11/24/27	Fr 663,539 Brit 320,473 US 1,921,477	Step-wise pressure hydrogenation at increasing temperatures with the removal of hydrogenation products formed.
4481	12/17/27	Germ 580,828 Fr 665,921 Brit 325,862 US 890,438	Pressure hydrogenation in several stages with a separation of high molecular weight products before the next stage.
5037	8/23/28	Germ 629,993 Fr 37,296 Fr 663,539 Brit 320,473 US 1,921,477	Pressure hydrogenation in several stages under more sharply defined conditions.
7134	6/25/31	Germ 668,949 Fr 738,970 Brit 380,615 US 1,984,596	Pressure hydrogenation of coal paste followed by pressure hydrogenation of the products formed in the liquid phase with a small amount of hydrogen, and leading the gaseous products obtained over catalysts under hydrogen pressure.
8070	3/14/25	Germ 608,467	See O.Z. 3105
8704	1/5/35	Fr 800,229 Brit 460,151	High phenol and olefin middle oils are broken down into two parts, the first part pressure hydrogenated under hydrogenating but little splitting and splitting pressure hydrogenation the products obtained with the remaining part.
9612	10/23/36	Germ 696,531 US 2,194,157	Pressure hydrogenation of oils in several stages. Separation of hydrogen and gasoline after the first stage, pressure hydrogenating the rest, returning all the reaction products and the hydrogen into the first stage.
9615	20/24/36	Germ 763,371	Pressure hydrogenation of coal in the liquid phase, pressure hydrogenation of middle oils, mixing of the hydrogenated middle oil with about 10 - 20% heavy oil obtained in the first stage (diesel oil).

The I.G. Serial Number O.Z.	Date	Patent	
10834	6/9/38	Germ 703,837	Breaking down petroleum middle oil with selective solvents. The low hydrogen fraction is pressure hydrogenated with a small absorption of hydrogen, the resulting products are pressure hydrogenated in the presence of strongly splitting catalysts.

e) Pretreatment

3343	10/26/25	Fr 624,941 Brit 262,099 US 1,823,116	De-watering of coal under pressure together with its own hydrogenation products, then pressure hydrogenating.
3503	3/24/26	Germ 503,351 Fr 627,758 Brit 292,217 US 1,681,335	Production of stable coal suspensions for hydrogenation by mechanical dispersion with the aid of bases, in organic liquids such as alcohols.
3511	3/30/26	Fr 631,459	Freeing tars or oils from catalyst poisons, then treating them catalytically with hydrogen.
3676 4477	7/21/26	Germ 527,519 Fr 637,838 Brit 274,858 US 1,881,968	De-watering of fuels by heating under pressure.
3850	11/26/26	Germ 554,366 Fr 643,735 Brit 281,247 US 1,863,669 US 1,864,855	Removal of bitumens prior to the pressure hydrogenation of coal.
4168	5/28/27	Germ 568,543 Fr 35,205 Fr 647,742 Brit 308,633 US 1,959,175	Pressure heating treatment of coal in the absence of solvents and hydrogen, followed by pressure hydrogenation.
4477	12/14/27	Fr 36,332 Fr 637,838 Brit 317,771 US 1,783,757	See O.Z. 3676

The I.G. Serial Number O.Z.	Date	Patent	
4631	2/14/28	Germ 590,098 Brit 320,918	De-watering of water-containing solid or liquid fuels with flushing gases prior to pressure hydrogenation.
4771	4/18/28	Fr 36,611 Fr 669,519 Brit 320,918	De-watering carbon containing substances in several stages prior to the pressure hydrogenation.
4794	4/26/28	Germ 630,891 Fr 673,824 Brit 333,550 US 1,910,050	Breaking down the liquid feed with selective solvents into hydrogen-rich and hydrogen-poor and pressure hydrogenating at least the hydrogen-poor portions.
4890	6/18/28	Fr 676,328 Brit 313,879 US 1,863,670	Preliminary hydrogenation of the feed for the removal of asphalts, separation of lubricating oil and paraffins, then splitting pressure hydrogenation and cracking.
5031	8/22/28	Germ 559,520 Fr 37,306 Fr 643,785 Brit 330,219 US 1,864,496	Extracting bitumene in steps during the pressure hydrogenation of bituminous coals and pressure hydrogenating the residues.
5165	20/24/28	Fr 682,995 Brit 329,671	Removal of paraffins from paraffin-containing tars. The tars are condensed to lubricating oils, the converted parts pressure hydrogenated to low boiling fractions.
5322	12/31/28	Fr 687,294 Brit 332,336	Removing with adsorbents high molecular weight substances from liquids containing them and pressure hydrogenating the liquid with the adsorbents.
5621	6/1/29	Fr 695,496	Eliminating oxygen and sulfur compounds by refining pressure hydrogenation in the liquid phase, without a preliminary hydrogenation of olefins, in the presence of catalysts of the II - VIII groups. Further treatment with hydrogen under pressure in the absence of catalysts.

The I.G. Serial Number O.Z.	Date	Patent	
5955	10/26/29	Germ 628,370 Fr 704,117 Brit 345,738 US 2,116,061	Removing the gum forming parts from raw benzol prior to the refining hydrogenation with fullers' earth and hydrogen.
6101 10464	1/16/30	Germ 710,073	Pressure hydrogenation of high boiling substances in the liquid phase with fixed bed catalysts after the removal of gummy and asphaltic substances, e.g. with adsorbents, chemically or by vacuum steam distillation.
6175	2/3/30	Germ 678,486 Fr 709,735 Brit 360,830 US 1,983,241	A protective distillation of the feed or the reaction products in a stream of hydrogen.
6595	7/29/30	Fr 718,180 Brit 363,040	Rapidly heating finely powdered baking coal in a weekly oxidizing atmosphere which casuses the particles to soften and to swell.
6679	9/4/30	Fr 721,795 Brit 368,955 US 1,993,386	Precipitation of asphalts and gums from tars and oils, pressure hydrogenating the de-asphaltized products together with the precipitant.
6847	12/6/30	Fr 726,314	Breaking down the liquid pressure hydrogenation products by distillation into several fractions and pressure hydrogenating these separately.
7106 8436	5/20/31	Fr 737,255 Brit 389,113	Refining of the hydrogenation feed with liquefied methane hydrocarbons, particularly propane.
7123	6/11/31	Germ 607,794 Fr 736,863	Eliminating the ash constituents of the coal to be hydrogenated and the addition of the substances decreasing the caking to coal, or extraction with solvents of the constituents causing caking.
7756	11/12/32	Germ 597,255 Fr 43,689 ~~Fr 750,296~~ Brit 407,227	Deashing coal by acid treatment prior to pressure hydrogenation.

The I.G. Serial Number O.Z.	Date	Patent		
7835 8240	1/13/33	Fr Brit	767,108 424,531	Treating gasoline, middle oil or heavy oil entirely or partially with hydrogen in the presence of hydrogenation catalysts below 300°C, then hydrogenating at normal or high pressures.
7962	5/13/33	Germ Fr Fr Brit	628,447 43,689 750,296 407,227	Pretreating coal with acids and pressure hydrogenating after the addition of non alkaline dispersants.
8059	8/18/33	Fr Brit	777,147 422,892	Coal is saturated prior to treatment with the solution of a catalytic and/or acid acting substance in the presence of wetting agents.
8063	8/29/33	Fr Brit	777,119 431,435	Catalytic material is added to coal in the presence of so much water that a homogeneous paste is formed, and the water is removed. Oil may be added before de-watering.
8088	9/19/33	Germ Fr Brit	678,621 779,457 428,749	Freeing coal mechanically from ash constituents and the addition of acid-reacting substances prior to or during the heating.
8092 10654 10655 10656	9/29/33	Germ Fr Brit	672,732 778,674 427,275	Saturating coal with catalysts which are partially or completely dissolved in an organic solvent.
8117	10/26/33	Fr	780,077	Wetting ground coal in a thin layer with an acid liquid in such amounts that no liquid is separated.
8160	11/18/33	Germ Fr Brit Brit Brit US	699,192 781,846 443,306 443,338 443,339 2,149,900	Breaking down mineral oils and tars into pitch and a hydrogen-richer portion by distillation under reduced pressures or by treating with precipitants or pressure hydrogenating the hydrogen-richer portions (high cut products to be pressure hydrogenated).

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8240	1/18/34	Germ Fr Fr Brit	685,595 45,467 767,108 433,593	See 7835
8330	3/31/34	Germ Fr Brit	696,315 787,780 439,366	Treating the liquid feed prior to pressure hydrogenation with so much dilute acids that only the organic nitrogen bases are dissolved and the olefins are not attacked.
8436	7/3/34	Fr Brit	788,919 448,334	See O.Z. 7106
8454	7/11/34	Germ	686,450	Step-wise precipitation of asphalt with the aid of precipitants, in particular propane, by step-wise rise in temperature.
8517	8/25/34	Fr	792,591	Heating coal prior to pressure hydrogenation to 280 - 400°C and leading away the carbon dioxide produced.
8669	12/12/39	Germ Fr	689,420 793,834	Keeping oxygen out of contact with coal prior to drying and up to the pasting with oil.
8985	8/3/35	Germ Fr Brit	675,957 807,936 463,602	Mixing of water sludge of the ground coal with hydrogenation residues, separating the water which separates with the ash and pressure hydrogenating the rest.
9041	9/26/35	Germ Fr Fr Brit Brit US US	695,470 800,971 800,972 452,158 452,095 2,154,527 2,194,186	Hydrogen-poor and oxygen-containing feed is pretreated under strongly hydrogenating conditions, then lead over catalysts treated with fluorine.
9221	2/1/36	Germ Fr	680,469 816,954	Treating coal with oxidizing substances prior to the pressure hydrogenation.

The I.G. Serial Number O.Z.	Date	Patent	
9237	4/16/36	Germ 719,199 Fr 816,314 Brit 471,112 US 2,123,245 US 2,123,246	Dehydrogenation of the pressure hydrogenation heavy oils before any later treatment.
9284	3/6/36	Fr 818,784	Resolving of the hydrocarbons boiling above 200°C with liquid aliphatic hydrocarbons, which contain over 10 carbon atoms, and pressure hydrogenating the asphalt containing portion.
9475	7/11/36	Fr 823,210	Resolving brown coal tar oil by extraction of liquid ammonia and treating the extract with alkali lye.
9568	9/17/36	Germ 722,406 US 2,206,729	Deashing liquid carbon-containing substances with carbon dioxide, conveniently with ammonia and $(NH_4)_2CO_3$ in the presence of water under pressure.
9590	10/7/30	US 2,206,729	Deashing liquid carbon-containing substances with acidified substance with large surfaces.
9595	10/10/36	Germ 724,667	Refining pressure hydrogenation followed by splitting pressure hydrogenation with both stages carried out in the presence of hydrogenation catalysts deposited upon carriers.
10004	5/27/37	Germ 704,296 Fr 838,185	Treating solid or semi-solid carbon-containing substances prior to pressure hydrogenation with sulfur, gaseous or volatilizable oxygen-free sulfur compounds or oxygen-containing organic sulfur compounds at elevated temperatures and under pressure.
10053	6/17/37	US 2,206,729	Deashing liquid carbon-containing materials with acids, including hydrogen sulfide, which do not attack the feed, conveniently with ammonia or $(NH_4)_2CO_3$ in the presence of water and under pressure.
10464	1/16/37	Germ 700,321	See O.Z. 6101

The I.G. Serial Number O.Z.	Date	Patent	
10587	3/4/38	Germ 711,439	Removal of aliphatic oxygen-containing substances such as alcohols, aldehydes, ketones or esters from the pressure hydrogenation products of oxygen-rich coals prior to the pressure heat treatment.
10603	3/9/38	Germ 697,518	Saturating coal with reaction water containing ammonium sulfide.
10632	3/22/38	Fr 850,899	Production of diesel oils from middle oils by resolving down into hydrogen-rich and hydrogen-poor portions, partial hydrogenation of the latter and blending with the hydrogen-rich portions.
10654		Germ 715,111	See O.Z. 8092
10655		Germ 688,916	See O.Z. 8092
10656		Germ 676,271	See O.Z. 8092
10830	8/30/37	Fr 841,528 Brit 505,953 US 2,232,673	Resolving down of coals with kogasin into two fractions. Pressure hydrogenation of the heavy fraction in the liquid phase, pressure hydrogenating the lighter fraction in the vapor phase for the production of gasoline and diesel oil.
11309 12209	1/23/39		Without increasing the portion boiling below 325°C, heating tars and mineral oils under pressure to 420 - 470°C, and pressure releasing into a space under such conditions causing a breaking down of a considerable proportion of the portion boiling above 325°C in vacuum into one which boils above 325°C at atmospheric pressure, separation of the pitch from the products forming vapors during the pressure release. The heating and pressure release may repeatedly be carried out after each other.
11310	1/23/39		Heating tars, mineral oils under pressure to 420 - 570°C as long as there is a considerable splitting off of the

The I.G. Serial Number O.Z.	Date	Patent	
11310	1/23/39		portion boiling above 325°C in vacuum into one which boils above 325°C at atmospheric pressure. Separation into pitch and vapors which are after-treated.
11875	12/23/39	Germ 736,668	Production of fuel oil from LTC tar by breaking it down into light and heavy fractions, hydrogenation of the heavy fraction and mixing the hydrogenation products with a lighter fraction.
12068	3/19/40		Prehydrogenation of aromatic hydrocarbon oils, contaminated with oxygen and nitrogen -containing compounds, using active alumina + oxides of the metals of the V + VI groups.
12189	3/19/37	Germ 734,721	Breaking down with selective solvents the fraction of carbon-containing substances boiling above 325°C into hydrogen-rich and hydrogen-poor substances, converting the latter by splitting pressure hydrogenation into middle oil, and aromatizing pressure hydrogenation of the middle oil and of the gasoline containing toluol.
12209	1/23/39		See O.Z. 11309
14246	6/19/43		Flotation of coal or oil shale prior to pressure hydrogenation using halogenated higher homologs of the cresol, in particular xylenol + soap solutions.
14733	5/9/44		Freeing tars and oils prior to pressure hydrogenation by alcoholic substances or by selective solvents from oxygen-containing compounds, in particular phenols, and freeing from nitrogen-containing compounds by a further pretreatment with strong acids.

The I.G. Serial Number O.Z.	Date	Patent	
f) Refining Hydrogenation			
3288	9/15/25	Germ 550,123 Fr 621,505 Brit 258,576 US 1,932,365	Refining raw benzol by catalytic pressure hydrogenation.
4214	6/24/27	Germ 665,228 Fr 655,230 Brit 315,439 US 1,897,798 US 1,932,369	Sulfur removal with hydrogen in the presence of metal sulfides under such conditions that no appreciable hydrogenation occurs.
4434	11/19/27	Germ 727,921 Fr 667,138 Brit 300,900 US 1,932,186	Refining volatilizable hydrocarbon mixtures by pressure hydrogenation in the vapor phase with catalysts non-sensitive to sulfur.
4793 6598	7/31/30	Germ 671,612 Fr 673,823 Brit 320,921 US 1,973,833	Refining of paraffins by pressure treating with hydrogen under mild conditions in the presence of elements of the III, IV or VI groups,, or nickel and/or cobalt together with bismuth and vanadium.
4809	5/8/28	Germ 720,002 Fr 667,138 Brit 327,463 US 1,932,186	Refining of high boiling oils in the liquid phase by catalytic pressure hydrogenation.
5067	9/8/28	Germ 551,687 Fr 37,363 Fr 621,505 Brit 327,194 US 1,975,475	Refining of raw benzol together with the pressure hydrogenation of coal middle oil and the like.
5133	10/20/28	Fr 682,363 Brit 332,251 US 1,920,888	Catalytic refining of knocking motor fuels with hydrogen under pressure mixed with aldehydes or alcohols.
5256 5768	12/3/28	Germ 629,886 Fr 685,687 Brit 333,511 US 1,908,286	Refining unsaturated or aromatic hydrocarbons with hydrogen over 200°C in the presence of sulfides or oxides of the II -VII groups, possibly with partial hydrogenation.

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Serial Number O.Z.	Date	Patent	
5768	7/31/29	Fr 685,687 Brit 333,511 US 1,908,286	See O.Z. 5256
6598	7/31/30	Germ 681,857 Fr 39,860 Fr 673,823 Brit 367,939 US 1,930,468	See O.Z. 4793
7130	6/22/31	Germ 613,726 Fr 738,100	Purification of raw phenols by refining pressure hydrogenation.
7149	7/13/31	Germ 665,535 Fr 739,860 Brit 388,864 US 1,989,626	Purification of waxes by refining hydrogenation.
7349	12/5/31	Germ 631,382 Fr 746,640 Brit 400,262 US 2,059,495	Purification of oxygen-containing hydrogenation products of carbon monoxide by refining pressure hydrogenation.
7834	1/12/33	Fr 763,575 Brit 416,976	Refining pressure hydrogenation of middle oils and gasoline in the liquid phase with the addition of finely divided catalysts.
7836	1/12/33	Germ 658,651 Fr 765,273 Brit 427,905	Refining hydrogenation of high boiling gasoline constituents, which consists predominantly of aromatic hydrocarbons, for the production of safety fuel.
7951	5/5/33	Fr 772,811 Brit 433,001	Hydrogenating pressure refining of raw gasoline with a gasoline partial pressure of 0.5 - 3 atm and hydrogen partial pressure of 30 - 60 atm in the presence of sulfides or oxides of the V and/or VI group, if necessary with oxides or sulfides of the heavy metals of the I and/or VIII groups.

The I.G. Serial Number O.Z.	Date	Patent		
8021	7/14/33	Germ	734,151	Refining pressure hydrogenation of ~~gasolines below 300°C in presence of~~ sulfides or iron, zinc, manganese, copper or tin as catalysts.
~~11743~~		~~Fr~~	~~774,343~~	
11744		Brit	424,748	
11745				
8436	7/3/34	Fr	788,919	Refining pressure hydrogenation at elevated temperatures of oils boiling at 200 - 400°C with liquefied hydrocarbons which are gaseous at room temperatures.
		Brit	448,334	
10595	3/8/38	Fr	846,480	Refining reduction and hydrogenation of liquid or fusible hydrocarbons by heating with at least equal volumes of cyclic hydrocarbons which give off hydrogen.
11743		Germ	713,208	See O.Z. 8021
11744		Germ	715,624	See O.Z. 8021
11745		Germ	714,810	See O.Z. 8021
14550	9/10/44			Purification of synthetic glycerine by catalytic pressure hydrogenation.
14714	4/19/44			The production of vaselines or refined oils from high boiling distillation residues by de-asphaltizing and if necessary by de-gumming of the feed and refining pressure hydrogenation of the refined product or of the paraffin obtained from it.
14810	6/24/44			Production of vaselines by refining pressure hydrogenation. Part of the de-asphaltized and possibly de-gummed feed is de-paraffined, and the paraffin-free oil is added to the not de-paraffined portion prior to the refining pressure hydrogenation. The two parts may also be subjected to refining pressure hydrogenation separately, and then blended.

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g) Production of Hydrogenation Lubricating Oils

4863	6/7/28	Fr Brit US	676,089 313,123 1,914,727	Condensation of tars or mineral oils in the presence of oxygen, sulfur or halogen-containing gases and pressure hydrogenation of the condensation products primarily into lubricating oil.
4943	7/17/28	Fr Brit US	678,328 315,764 1,920,887	Pressure hydrogenation of coal without the formation of gasoline followed by extraction with solvents for the production of lubricating oil and paraffin.
6084	6/22/28	Germ	729,769	Refining pressure hydrogenation of raw lubricating oil in the vapor phase.
7108	5/23/31	Germ Fr	571,792 736,557	Joint distillation of pressure hydrogenation products and other oils for the purpose of production of lubricating oils.
7284	10/13/31	Fr	743,816	Improvement of lubricating oils in the liquid state by pressure hydrogenation below 300°C.
7705	9/17/32	Fr Brit	760,861 407,379	Mixing of the lubricating oils obtained by the pressure hydrogenation of paraffin-base petroleum oil with condensation or polymerization products of paraffins, hydrogenation products of caoutchouc or gums or of polymerization products of olefins.
8055	8/15/33	Germ Fr Brit	632,866 776,585 425,814	Pressure hydrogenation of coal paste with such small thruput that over 90% of the carbon is hydrogenated and the liquefied oil contains less than 2% asphalt and the fraction boiling above 325°C can be treated by extraction, refining or precipitation means or with hydrogen under pressure.
8196	12/14/33	Germ Fr	689,360 781,549	Resolving of the feed containing lubricating oils with selective solvents into hydrogen-rich and hydrogen-poor portions and hydrogenating of at least part of these portions.

The I.G. Serial Number O.Z.	Date	Patent	
8237	1/16/34	Fr ~~Brit~~	740,034 ~~433,061~~
8244	1/20/34	Fr Brit Brit Brit US US	784,319 435,548 435,597 435,598 2,140,545 2,258,806
8334	4/5/34	Germ Fr	688,736 788,260
8677	12/18/34	Fr Fr	46,818 676,328
8693	12/29/34	Germ Fr Brit	709,022 800,965 450,721
9081	11/5/35	Germ Fr	711,376 812,228

Hydrogen-poor hydrocarbons are subjected to a silent electrical discharge and pressure hydrogenated for the production of lubricating oils.

Carrying out of the hydrogenation in the presence of oxidation-inhibiting substances.

Production of lubricating oil and paraffin from the pressure hydrogenation products of brown coal, separation of asphalts and gums, precipitation of the paraffins of different molecular weight by a step-wise cooling and pressure hydrogenation after any desired stage of the process.

Separation of paraffins from pressure hydrogenation products, converting the rest by pressure hydrogenation into lubricating oil or low boiling hydrocarbons.

Paraffins from coal by mild extraction and pressure hydrogenation of the extract, avoiding splitting.

Production of lubricating oils from brown coal or peat in three stages. Pressure hydrogenation of the raw material below 430°C to asphalt-rich heavy oil, pressure hydrogenation of the latter in the liquid phase with finely divided catalysts, pressure hydrogenation of the fraction boiling above 325°C over fixed bed catalysts below 430°C to lubricating oils.

The I.G. Serial Number O.Z.	Date	Patent	
h) TTH Process			
9533	8/15/36	Germ 696,083 US 2,206,729	Pressure hydrogenation of high boiling oils containing asphalts and gums in the presence of organic solvents and fixed bed catalysts at 270 - 380°C under such mild conditions that a maximum increase of 10% of the oils boiling below 350°C is produced by the reduction of the asphalts and gums.
9656	11/19/36	Germ 695,275 US 2,206,729	Pressure hydrogenation of high boiling oils containing asphalts under such mild conditions that a maximum of 20% increase is obtained of the oils boiling below 350°C.
9657	11/20/36	Germ 725,600 US 2,206,729	Pressure hydrogenation of high boiling asphalt-containing oils in presence of fixed bed catalysts or with the addition of large amounts of finely divided catalysts, below 400°C with such a small thruput that the increase of the oil boiling below 350°C during the reduction of the asphalt is over 10%, with however a maximum of 15%.
10097	7/17/37	Germ 745,445	Pressure hydrogenation of asphalt-containing oils at rising temperatures in such a way that the asphalts are reduced and the portion boiling below 350°C is increased by 10% or less.
10119	7/22/27	Germ 695,471	The catalysts in the first part of the reaction space are only half as active as in the rest of the space.
10128	7/28/37		Permit the temperature to rise over 400°C after using the TTH process with an increase of over 20% of the portion boiling below 350°C.
10641	3/29/38	Germ 704,233	A feed which foams below 325°C in the vacuum and/or appears non homogeneous under a microscope is prehydrogenated below 300°C before the TTH process.

The I.G. Serial Number O.Z.	Date	Patent	
10711	5/15/35	Fr 807,157 Brit 477,630	The use of electrically conducting catalysts through which direct and/or alternating current is passed.

i) Pressure Extraction

3894	12/22/26	Fr 647,742 Brit 282,691 US 1,904,586	Pressure extraction of solid carbon-containing substances such as coal with oils boiling above 300°C, if necessary with the addition of gases, such as small amounts of hydrogen.
3942	1/13/27	Fr 647,742 Brit 283,545 US 1,904,477	Pressure extraction of coal with oils boiling between 100 - 300°C, in particular middle oils, if necessary with the addition of gases, such as a small amount of hydrogen.
4062	3/18/27	Germ 567,330 Brit 301,946 Fr 650,722 US 1,822,349	Heating coal under pressure, then extracting.
4488	12/22/27	Fr 666,051 Brit 311,031	Pressure extraction of coal in presence of non-metals.
4655	2/24/28	Germ 541,755 Fr 669,519 Brit 320,918	Pressure extraction of coal. Dehydration in vacuum in presence of solvents.
4824	5/18/28	Germ 695,268 Fr 675,073 Brit 312,050 US 1,988,019	Pressure extraction of coal followed by pressure hydrogenation of the residues.
4828	5/19/28	Brit 322,749	Extraction of bituminous substances with pressure hydrogenation or cracking products boiling between 80 - 150°C and containing a high proportion of aromatic compounds.
5185	11/7/28	Fr 37,543 Fr 647,742	Pressure extraction of coal with intensive mechanical comminution followed by pressure hydrogenation.
9153	12/14/35	Germ 700,372	Pressure extraction prior to filtration or centrifuging and heating to 150 - 300°C.

The I.G. Serial Number O.Z.	Date	Patent	
9167	12/21/35	Germ 699,552 Fr 813,846 Brit 466,524	Production of heavy oil by pressure extraction or mild pressure hydrogenation of coal. Precipitation of the higher molecular weight constituents at elevated temperatures and under pressure using aliphatic hydrocarbons with 4 - 9 C atoms, using the middle oil and the asphalt for pasting of fresh coal.
9168 11372 11373 11374 11375 11377	12/21/35	Germ 711,380 Brit 469,914 Brit 466,336	Pressure extraction or pressure hydrogenation with small supply of hydrogen in the presence of mineral acids, carboxy acids and chlorine, bromine, halogen compounds of solid non metals, e.g. organic halogen compounds or ammonium chloride, as well as of heavy metals, organic compounds of the oxides of the heavy metals of the IV to VIII groups, conveniently in the presence of gaseous or volatile sulfur compounds, heavy metal sulfides, metals of the iron group or their compounds, e.g. with iron or iron oxide or nickel nitrate + alkali or halides of molybdenum, tungsten, vanadium or by the addition of acid-reacting substances in such amounts that the basic constituents of the coal are neutralized.
9188	1/16/36	Germ 708,258 Fr 816,371 Brit 469,048	Production of fuel oil or motor fuel by pressure extraction or mild pressure hydrogenation of coals. Precipitation of high molecular constituents with propane, ethane or methane and mixing them with the cyclic middle oils. The dissolved fraction is used as a pasting oil.
9505	7/23/36	Germ 663,542 Fr 823,961 US 2,215,190	The addition of thinners to coal extracts, distilling off the extraction means and pressure hydrogenation of extract and thinners.
9541	8/15/36	Germ 732,278 Fr 824,744 Brit 481,108 US 2,223,184	Separating the pressure extract or the deashed products of mild pressure hydrogenation into wax and asphalt-like groups by mechanical means.

The I.G. Serial Number O.Z.	Date	Patent	
9572	9/19/36	Fr 826,454	Pressure hydrogenation of coal extraction products with the addition of iron or its oxides.
9598	10/13/36	Fr 827,600	Pre-extracting bituminous substances, extracting under more rigid conditions, pressure hydrogenating the extract.
9658	11/21/36	Germ 696,501 US 2,215,869	Pressure hydrogenating the products of coal extraction, adding the non vapor-forming hydrogenation products to the make-up extract for hydrogenation.
9747	1/13/37	Germ 710,867	Extraction of brown coal with a fraction of the pressure hydrogenation boiling between 170 - 260°C, conducting pressure hydrogenation in such a way that the fraction would contain 5 - 40% cresol.
9793	2/6/37	Germ 717,805 Fr 833,315	Mixing of solid and liquid substances with the introduction of low boiling substances.
10186	8/25/37	Fr 841,727	Pressure extraction of coal with 8 - 18% water in the presence of hydrogen.
10220	9/20/37	Germ 748,463 Fr 842,464 Brit 503,480	Improving powdered combustion and power fuels obtained by pressure extraction by treating with oxygen at elevated temperatures below the kindling temperature.
10230	9/29/37	Germ 696,402 Fr 843,842 Brit 503,200 US 2,230,812	Production of phenols from phenolic gums by pressure extraction with solvents above 300°C.
10291	10/23/37	Germ 705,178 Fr 845,004	Improving the filterability of the products obtained in the pressure extraction and mild pressure hydrogenation in the presence of small amounts of hydrogen by removal during the extraction of a small proportion of the products at the bottom end of the vertical reaction vessel.

The I.G. Serial Number O.Z.	Date	Patent		
10299 12385	10/26/37	Germ Fr Brit	731,364 843,842 503,200	Improving the powdered combustion and power fuels obtained by pressure extraction, by treating part of it with oxygen at elevated temperatures, the other part with nitric acid or oxides of nitrogen, and mixing the products.
10424	12/20/37	Fr Brit	847,150 508,482	Decomposing of the pressure extract of coal or the coal hydrogenation products with selective solvents, treating the asphaltic constituents with the oxides of nitrogen for the production of powdered fuels.
10432	12/23/37	Germ	720,826	The introduction of hydrogen-free or hydrogen-poor gases behind the first third of the reaction space during the pressure hydrogenation of coal, so that only a partial hydrogenation will take place with the production of a readily filterable product.
10531	2/10/38	Fr Brit	842,464 503,480	Improving the powdered combustion and power fuels obtained by pressure hydrogenation by treating with oxygen at elevated temperatures + liquid fuels.
10532	2/10/38	Germ Fr	722,810 849,803	Obtaining powdered high melting combustion and power fuels from the pressure extracts by the removal of the low melting fractions by mechanical separation or distillation and/or treating with selective solvents.
10586	3/3/38	Germ Fr Brit	725,608 850,493 522,096	Pressure extraction with hydrogen and catalysts in presence of an extraction means consisting of middle oils containing less than 10 g hydrogen to 100 g carbon and of small amounts of hydrogen-rich oils containing at least 14 g hydrogen to 100 g carbon.
10592	2/10/31	Germ	701,826	Pressure extraction of coal with oils in bundles of tubes under pressure in fixed arrangement in a heating chamber.

The I.G. Serial Number O.Z.	Date	Patent	
10708	10/30/34	Austr 152,829 Fr 800,920 Brit 468,680 US 2,167,250	The production of soluble and fusible solid bituminous hydrocarbons (primary bitumen) from solid carbon-containing substances by treating with hydrogen under pressure and at elevated temperatures in the presence of solvents of an aromatic or naphthenic kind, operating with an insufficient amount of hydrogen in comparison with the absorption capacity of the carbon containing substances.
10713	7/13/35	Germ 700,774	Production of fuel oils and diesel fuels by dissolving primary bitumens and oils, obtained by low temperature carbonization or protective hydrogenation of bitumen-like hydrogenation products.
10714	7/13/35		Diesel fuels consisting of solid bituminous hydrocarbons, such as asphalts, pitches, cracking residues and similar bitumens, fused or dissolved in hydrogen-poor solvents, such as tar oils or the products of weak hydrogenation of solid bituminous materials.
10719	2/1/36	Fr 48,125 Fr 800,920 Brit 489,664	Extensive replacing of the pasting oil of low hydrogen content with primary bitumen, pitch or cracking residues.
10827 11816	5/30/36	Austr 153,978 Fr 819,660 Brit 476,411	Production of fuel oils and diesel fuels. Solutions of primary bitumen or coal extract in hydrogen-poor oils freed from high molecular weight substances by an oil which precipitates them. The precipitant is recovered by distillation.
11055	9/24/38	Germ 708,432	The production of ozokerite-like substances by breaking down brown coal extracts into hydrogen-rich and hydrogen-poor fractions and removing the paraffin from the hydrogen-rich fractions. The paraffins or the hydrogen-rich fractions of the extract are mildly hydrogenated at about 250°C avoiding splitting.

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Serial Number O.Z.	Date	Patent		
11185	12/7/38	Germ	712,311	Heating the feed with adsorbents during pressure hydrogenation with small amounts of hydrogen and adding the hydrogenation catalysts only to the reaction vessel.
11372		Germ	707,813	See O.Z. 9168
11373		Germ	719,536	See O.Z. 9168
11374		Germ	711,711	See O.Z. 9168
11375		Germ	714,909	See O.Z. 9168
11377		Germ	711,712	See O.Z. 9168
11816		Germ	739,556	See O.Z. 10827
12331	8/27/40	Germ	750,238	Production of gums from coal by pressure extraction or mild pressure hydrogenation and low temperature carbonization of the products and separation of the gums from the low temperature tar by distillation or by precipitants.
12385		Germ	733,905	See O.Z. 10299

k) The Use of Partially Hydrogenated Coal for the Production of Coke

10740	5/7/38	Germ Fr	735,726 853,715	Compressing coal with high boiling hydrogenation products or pressure extraction products, low temperature carbonisation of the compressed mass at about 500°C for the production of tar and low temperature carbonization coke.
11067	10/6/38	Germ Fr	738,621 853,715	Low temperature, carbonization of a mixture of comminuted coal with high boiling products of pressure hydrogenation, with an asphalt content of over 50% referred to the ash content, and at least 2% in the mixture.
11250	12/31/38	Germ Fr	745,161 853,715	

The I.G. Serial Number O.Z.	Date	Patent		
11250	12/31/38	Germ Fr	745,161 853,715	Low temperature carbonization of a mixture of coal with high boiling products of pressure hydrogenation or residues in such proportions that when mixed at 50 - 150°C solid cohering pieces are obtained.
11485	4/19/39	Germ Fr	736,971 853,715	Low temperature carbonization of a mixture of coal and high boiling products of pressure hydrogenation or residues in a proportion of 0.05 and 0.3 parts by weight of the hydrogenation products to one part by weight of the mixture.
11660	7/14/39			Low temperature carbonization of a mixture of baking bituminous coal or brown coal, peat, or partially de-gased coal and of high boiling products of pressure hydrogenation of coal.
11679	7/27/39			Production of compressed masses from baking bituminous coal, previously dusted with a dust of non baking coal or of peat, at slightly elevated temperatures, and conveniently with the addition of high boiling hydrogenation products.
11891	12/4/39			Low temperature carbonization of mixtures of coal with high boiling products of pressure hydrogenation, with an added binder for the production of compressed masses.
11901	12/11/39			Production of fuel oil and solid coke by low temperature carbonization and pressure hydrogenation. The pasted coal is pressure hydrogenated to fuel oil. The hydrogenation residue is pressed into shape with fresh coal and carbonized at low temperatures. The low temperature carbonization tar is used for the pasting of coal for the pressure hydrogenation.

The I.G. Serial Number O.Z.	Date	Patent		
12115	4/24/40	Germ Fr	741,586 888,733	Use as a briquetting agent of a product of heating to 250 - 450°C of a mixture of bituminous coal with low temperature carbonization tar or its high boiling hydrogenation products or the hydrogenation products of bituminous coal.
12160	5/24/40			Production of tar and solid coke by low temperature carbonization of a mixture of coal with the products of pressure extraction of coal.
12510 13221 13223 13876 14775 14800	12/21/40	Fr	881,168	Pressure hydrogenation residues or pressure extracts are converted into materials with a softening point of 45 - 150°C preferably 60 - 100°C by distillation, extraction, addition of pitch or organic solvents or by treating with oxygen-containing gases and then mixing with at least 5% of a solid carbon-containing material or an inorganic absorbent, the mixture if required being pressed, and carbonized at low temperatures, burned or gasified.
12705	4/12/41			See O.Z. 12510
12719	4/12/41			See O.Z. 12510
12921	7/29/41			Fusible bituminous products obtained by pressure extraction or by protective pressure hydrogenation of coal carbonized at low temperature under pressure for the production of coke.
13218	1/28/42			Production of solid coke by low temperature carbonization of asphalt-containing residues with the addition of metal hydroxides or carbonates.
13221	1/26/42			See O.Z. 12510
13223	1/28/42			See O.Z. 12510

The I.G. Serial Number O.Z.	Date	Patent	
13264	2/19/42		Production of high grade coke and fuel oil by low temperature carbonization of coal with a binder obtained by incomplete hydrogenation or by pressure extraction of coal using a pressure-distilled low temperature carbonization tar as a pasting oil.
13876	12/28/42		See O.Z. 12510
14115	3/31/43		Production of carbon electrodes by using an asphaltic binder obtained by a protective hydrogenation of coal with an insufficient amount of hydrogen.
14116	3/31/43		Production of carbon electrodes using an asphalt-containing binder produced by treatment of tars and mineral oils with liquefied hydrocarbons, gaseous at room temperature.
14751	5/20/44		Grinding of the solid products of low temperature carbonization of the hydrogenation residue still retaining 0.5-1% oil to a fineness of about 0.1 mm and compressing to briquettes in the dry state without the addition of a binder under a pressure of at least 700 atm.
14775	6/5/44		See O.Z. 12510
14800	6/16/44		See O.Z. 12510

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III Raw Materials and Finished Products

a) Special Raw Materials

3541 7677	4/22/26	Fr 624,843	Improving the quality of gums by pressure hydrogenation of high molecular weight polymerization products of olefins and gums by mechanical treatment, in part de-polymerization, then pressure hydrogenation to highly viscous lubricating oil-like product.
4529 5556	1/13/28	Fr 667,241 Brit 322,445 US 1,960,977 US 1,999,738	Production of hydro-aromatics in the presence of sulfur resistant catalysts, conveniently upon carriers at temperatures below 350°C.
5387	1/30/29	Germ 647,178 Brit 336,616	Production of hydro-aromatics from the corresponding phenols using hydrogen under pressure and in presence of the oxides or sulfides of the metals of the II - VII and the metals of the VIII and heavy metals of the first group.
5471	3/8/29	Fr 691,244 Brit 340,470 Brit 349,892	Pressure hydrogenation of residues obtained in the condensation or refining of hydrocarbons.
5556	4/27/29	Fr 38,193 Fr 667,241 Brit 336,583 US 1,965,956	See O.Z. 4529
5926	10/15/29	Fr 564,208 Brit 352,537 US 2,048,662 US 2,102,726 US 2,227,659	Production of alcohols by pressure hydrogenation of the oxidation products of high molecular weight hydrocarbons.
6599	8/1/30	Germ 565,734 Fr 39,709 Fr 689,713	Production of wax-like materials by catalytic pressure hydrogenation of high molecular weight organic acids or their derivatives with low molecular weight alcohols.

The I.G. Serial Number O.Z.	Date	Patent	
~~6865~~	~~12/16/30~~	Germ 599,581 Fr 39,709 Fr 689,713 Brit 356,731 US 2,093,159	Production of waxes and wax-like materials by catalytic hydrogenation of high molecular weight fatty acids, aliphatic oxy acids, their salts, amides, anhydrides, esters etc.
7052	4/13/35	Germ 630,823 Fr 734,879 Brit 389,171 US 1,998,595	Production of liquid benzol hydrocarbons by catalytic treatment of naphthalene with hydrogen under pressure in presence of MoO_3 or WO_3 -containing catalysts
7301	10/30/31	Germ 636,385 Fr 743,570 Brit 397,901	Reduction of phenols with hydrogen under pressure in presence of catalysts, e.g. sulfides of the metals of the VI group, to aromatic hydrocarbons, e.g. conversion of raw cresol into toluol.
7677	8/23/32	Germ 597,086 Fr 761,252 Brit 411,894 US 2,093,096	See O.Z. 3541
7779	12/2/32	Fr 709,734 Fr 762,002 Brit 354,441 Brit 409,696 US 2,111,126	After-treatment by pressure hydrogenation of condensation products of paraffins or of olefins obtained by dehydration of higher alcohols with cyclic hydrocarbons.
7807	12/23/32	Germ 615,148 Fr 765,379 Brit 415,203	Pressure hydrogenation of fats and fatty oils by the use of heavy metal sulfides.
8640	11/24/34	Fr 798,084	Improvement of asphalts by pressure hydrogenation with the addition of hydrogen, but without appreciably reducing the oxygen content of the asphalts.
8727	4/21/28	Germ 623,001	Hydrogenation of phenols with difficultly reducible metal-oxygen compounds with the production of liquid hydrocarbons.
9452	7/2/36	Germ 711,888 Brit 478,306	Improving the quality of artificial gums by treating with hydrogen and hydrogenation catalysts.

The I.G. Serial Number O.Z.	Date	Patent	
~~10035~~	~~6/11/37~~	~~US 2,215,876~~	~~Polymerization of olefins in presence of sulfides of molybdenum and/or tungsten together with the sulfides of nickel and/or cobalt.~~
10154	8/6/37		Heating to 200 - 400°C lignite-containing masses before pressure hydrogenation.
10682 13460		Fr 853,148	The production of saturated monovalent alcohols by pressure hydrogenation of 1, 4 butine diol in the liquid phase at below 100°C.
10758	5/9/38	Fr 854,502 US 2,228,118	Treating knocking hydrocarbons by heating the liquid reduction products of carbon monoxide with hydrogen-poorer hydrocarbons at pressures above 350 atm + hydrogen in the presence of fixed bed catalysts.
11048	11/17/32		Production of hydrocarbons by catalytic pressure hydrogenation of ketones obtained by catalytic splitting of carbon dioxide from the carboxy acids.
12277	7/30/40		The production of anti-knock gasoline, especially of iso hexane (2,3 dimethyl butane) from aldehydes obtained from olefins + carbon monoxide + hydrogen (e.g. iso valeric aldehyde) by condensation to hydrocarbons with formaldehyde in the presence of secondary or tertiary amines and pressure hydrogenation of the high molecular weight aldehydes (e.g. iso propyl acrolein).
12339	9/4/40		Production of anti-knock gasolines, in particular 2,2,3 trimethyl butane, 2,2 dimethyl pentane, by condensation of aliphatic aldehydes containing at least one hydrogen atom in the group adjoining the aldehyde group, either with themselves or with other aliphatic aldehydes, and pressure hydrogenating the condensation products obtained to hydrocarbons.

The I.G. Serial Number O.Z.	Date	Patent	
12785	5/22/41	Germ 750,879 Fr 887,348	The production of liquid hydrocarbons from oil shale by low pressure carbonization of the lumps and extraction of the fines and pressure hydrogenation of the shale oil.
13386	4/20/42		Production of anti-knock motor fuels by hydrogenation of the condensation products of ketones with formaldehyde.
13916	1/14/43		Production of motor fuels from polyvalent alcohols produced from carbon monoxide + hydrogen together with raw gasoline obtained by low temperature carbonization and coking of coals, treating with hydrogen under hydrogenating conditions and at increased pressure in the presence of hydrogenating catalysts.
14190	5/20/43		Production of anti-knock gasolines from aldehydes or ketones containing one or more methyl or methylene groups in positions next to the carboxyl group, by condensation with formaldehyde and reduction by pressure hydrogenation of the high molecular weight aldehydes to hydrocarbons.
14191	5/20/43		See O.Z. 14190
14825	6/24/44		Production of anti-knock gasolines by the chlorination of aliphatic ketones boiling below 250°C and containing at least one secondary or tertiary C atom in an alkyl group. Heating the monochlor compounds with alkaline substances suspended in non aqueous solution, and pressure hydrogenation of the acid set free from the resulting salt below 300°C in the presence of strongly hydrogenating catalysts.

The I.G. Serial Number O.Z.	Date	Patent	
b) Hydrogen and Hydrogenation Off-gas			
3226	7/2/25	Fr 617,504 Brit 254,713 US 1,876,009 US 1,890,434 US 1,931,549 US 2,005,192 US 1,931,550 US 1,983,234 US 1,996,009 US 2,006,996 US 1,994,075	Production of hydrogen from gaseous hydrocarbons by conversion with oxygen.
3604	6/11/26	Fr 634,821 Brit 272,538 US 1,859,314	Washing the hydrogenation off-gases with gasoline under pressure.
3781	10/14/26	Fr 34,048 Brit 617,504 Brit 279,072 US 1,919,857	Production of hydrogen from gaseous hydrocarbons by conversion with carbon dioxide.
4226	6/30/27	Fr 654,316 Brit 305,603	Production of hydrocarbon derivatives from hydrogenation off-gas by treating with sulfur-and oxygen-containing gases.
4601	2/3/28	Fr 668,668 Brit 329,688	Re-use of hydrogenation off-gas after removal of hydrogen sulfide by washing under pressure with organic liquids (middle oils) to 0.3 volumes.
4889	6/18/28	Germ 614,859 Fr 675,789 Brit 322,734 US 1,954,096	Fractional pressure release of the condensed hydrogenatón products under pressure for the production of hydrogen-poorer and hydrogen-richer gas fractions.
5174	11/1/28	Fr 681,346 Brit 325,968 US 1,938,087	Separation of hydrogen from gas mixtures by washing with coal sludges, tars, mineral oils which are to be pressure hydrogenated.
6116	1/18/30	Fr 708,165 Brit 364,106	Converting gaseous hydrocarbons by step-wise thermal treatment at increasing temperatures into hydrocarbons with lowered hydrogen content, e.g. olefins or aromatic hydrocarbons.

The I.G. Serial Number O.Z.	Date	Patent	
6631	8/19/30	Fr 718,344	Pressure hydrogenation with electrolytic hydrogen previously freed from oxygen with the aid of catalysts.
6640	8/22/30	Germ 648,129 Fr 718,704 Brit 365,276 US 1,990,70[illegible]	Pressure hydrogenation with hydrogen obtained in de-gasifying of solid fuels and freed from unsaturated hydrocarbons, oxygen, oxides of nitrogen and sulfur compounds.
6698	9/16/30	Germ 545,602	De-sulfurizing with nitrosyl sulfuric acid in the absence of oxygen.
6785	10/29/30	Germ 554,177 Fr 723,443 US 1,984,971	De-sulfurizing by step-wise catalytic oxidation of hydrogen sulfide to sulfur, using activated charcoal + oxygen.
6913	1/17/31	Germ 552,446 Fr 729,119 Brit 376,358 US 2,038,566	Production of hydrogen by catalytic conversion of hydrocarbons with steam, carbon dioxide or air in presence of metals of the iron group + hydraulic binders as catalysts.
6914	1/17/31	Fr 729,429 Brit 379,013 US 2,056,911	Production of hydrogen by catalytic conversion of high molecular weight gaseous hydrocarbons with steam.
6967	2/20/31	Fr 731,308	Working up the hydrogenation off-gases by washing with non volatile oils under pressure and low cooling.
6973	2/24/31	Germ 598,366 Fr 731,539 Brit 380,164 US 1,977,992	Production of hydrogen from hydrocarbon-containing gases with different hydrocarbon contents by preliminary washing concentration of the hydrocarbons present in a gas in a larger amount to the concentration of the other gas, followed by washing of the two gases together.
7182	8/5/31	Fr 740,663	Conversion of hydrocarbon-containing gases with steam or oxygen and conversion of the carbon monoxide-hydrogen mixture in presence of iron and nickel as catalysts.
7264	9/23/31	Germ 624,437	Production of light gasoline from gases by washing or adsorption, driving off the light gasoline and pressure distillation of the light gasoline under lower pressure as the light gasoline is driven off.

The I.G. Serial Number O.Z.	Date	Patent	
7294	10/23/31	Fr 742,842	Production of hydrogen from gaseous hydrocarbons by blowing the mixture with steam + carbon dioxide through a layer of fine fuel upon a grate in such a way as to keep the whole height of the layer in motion.
8298	3/9/34	Germ 669,661 Fr 793,876 Brit 450,705	Branching off part of the hydrogenation gas from the circuit purifying it and returning to the circuit.
8302	3/10/34	Fr 785,617 Brit 431,970	Scrubbing the hydrogenation gases with liquefied hydrocarbons which form gases at room temperatures.
8896	5/24/35	Germ 709,259 Fr 809,352 Brit 463,333	Purification of hydrogenation gases and the production of lighter hydrocarbons by the addition of the hydrogenation off-gases to the vapor phase pressure hydrogenation. The separation of the lighter hydrocarbons from the off-gases of the vapor phase hydrogenation.
9559	9/5/36	Germ 728,674 Fr 825,085 Brit 481,607 US 2,203,842	Converting saturated gaseous hydrocarbons with hydrogen under pressure and at a high partial pressure of the gaseous hydrocarbons at above 450°C in the presence of hydrogenation catalysts into low boiling hydrocarbons.
9812	2/17/37	Fr 832,742 Brit 492,503 US 2,189,062	Separating propane and/or butane from gaseous mixtures by scrubbing with liquefied halogenated hydrocarbons which are in the gas or vapor form at room temperatures.
11231	12/27/38		Dehydrogenation of gaseous homologs of methane in the presence of hydrogen at 500 to 800°C and a pressure of 3 to 100 atm, with the partial pressures of the hydrocarbons forming less than 25% of the total pressure.
11648	7/8/39	Germ 713,135	Pressure hydrogenation with impure hydrogen heated before its intake into the compressor or the circulation pump above its dew point.

The I.G. Serial Number O.Z.	Date	Patent	
13168	12/24/41		~~Dehydrogenation of gaseous hydrocarbons~~ in several stages heating the products between each stage.
13525	6/27/42		Separating of hydrogen sulfide from gases. The used up scrubbing liquid is freed from most of the hydrogen sulfide and part of the carbon dioxide by heating under pressure and re-used.
14957	8/21/44		Dehydrogenation of gaseous hydrocarbons. Compounds of the elements of the I or II groups or of manganese or of the metals of the iron group or several of these are added in small amounts to the hydrocarbons prior to the inlet into the reaction vessel in such a way as to have the former in a fog or vapor form.
14958	9/22/44		See O.Z. 14957

c) Working Up Hydrogenation Products

3247	7/27/25	Germ 536,794 Fr 619,179 Brit 255,905 US 1,960,974	Separation of hydrogenation products with methanol and cyclohexane.
3267	8/20/25	Fr 619,179 Brit 257,270 US 1,822,351	A process of working up of hydrogenation products with the lower alcohols (methanol)
3388	12/21/25	Germ 489,346	Improving hydrogenation products by selective treatment with liquid ammonia.
3593	6/5/26	Fr 634,857 Brit 298,584 US 1,823,495	Polymerizing of hydrogenation oils to high molecular weight hydrocarbons, in particular to rubber like substances.
3625	6/18/26	Fr 634,857	Working up of hydrogenation oils by the addition of the halogens.
3646	7/5/26	Germ 472,076 Fr 626,712 Brit 291,817 US 1,732,371	Purification and separation of hydrogenation products by extraction with alkyl formate.

The I.G. Serial Number O.Z.	Date	Patent	
4084 4174	3/26/27	Fr 650,573 Brit 302,941 Brit 309,228 Brit 309,227 Brit 309,229 US 1,881,691	Separation of oils from mixtures with solid substances after the addition of wetting agent-containing solutions.
4095	3/31/27	Fr 650,975 Brit 288,148 US 1,927,244	Driving out of oil from hydrogenation residues by heating with flushing gases, e.g. in worm drive furnaces.
4174	6/1/27	Fr 650,573 Brit 302,941 Brit 309,227 Brit 309,228 Brit 309,229 US 1,881,691	See O.Z. 4084
4275	7/29/27	Fr 657,585 Brit 317,506 US 1,925,566	Driving out the oil on heated surfaces from hydrogenation residues in a pasty or viscous state.
4338	9/5/27	Germ 529,807 Brit 312,383	Separation of oils from mixtures with solids by extraction followed by centrifuging.
4356	9/26/27	Brit 302,941 Brit 309,227 Brit 309,228 Brit 309,229	Separation of oils from mixtures with solids by addition of emulsifiers.
4391	10/25/27	Germ 550,157 Fr 632,387 Brit 314,405 US 1,794,865	Separation of oils from mixtures with solids such as hydrogenation residues by centrifuging after the addition of solvents.
4394	10/27/27	Fr 661,327 Brit 312,657 US 1,904,521	Separation of hydrogenation residues by continuous extraction with solvents.
4484	1/5/28	Germ 486,309 Fr 646,703 Brit 283,159 US 1,840,287	Working up of the oil-containing materials such as hydrogenation residues; with liquid sulfur dioxide.

The I.G. Serial Number O.Z.	Date	Patent	
4591	1/28/28	Fr 36,503 Fr 661,327 Brit 323,791 US 1,864,856	Separation of oils obtained in pressure hydrogenation from solid residues by extraction with pressure hydrogenation products boiling below 150 - 300°C and filtering.
4706	3/16/28	Germ 543,285	Separation of oils from mixtures with solids by using sulfur dioxide under pressure.
4827	5/14/28	Germ 541,470	Separation of oils from mixtures with solids by treating with steam upon porous supports with steam.
4831	5/22/28	Brit 312,228 US 1,912,856	Separation of oils obtained in the pressure hydrogenation from the solid residues by the addition of flocculating substances (acids, salts).
4834	5/23/28	Fr 37,096 Fr 643,312 Brit 320,211	Saturating porous materials with hydrogenation residues, rapidly heating to red heat and cooling for the production of olefins and aromatics.
5021	8/15/28	Fr 682,158 Brit 328,997 Brit 329,331 US 1,881,969	Fractionation of pressure hydrogenation products by passing gases or vapors through them or by rapid outside cooling.
5098	9/22/28	Germ 581,941 Fr 680,465 Brit 331,916 US 1,933,069	Injecting scrubbing oil into the gases and vapors drawn out of the reaction space.
5103	9/25/28	Fr 680,466 Brit 319,657 US 1,989,822	Low cooling or compression of hydrogenation products in the form of vapors and gases for the separation of the difficultly condensible products.

The I.G. Serial Number QZ.	Date	Patent	
5231	4/21/28	Germ 536,190 Fr 653,024 Brit 309,501	Injection of liquid hydrogenation residues into the gases and vapors obtained during low temperature carbonization of powdered or dust-forming coal.
5381	1/29/29	Fr 37,920 Fr 653,024 Brit 330,723 US 1,950,811	Working up oil-containing hydrogenation residues by coking with natural carbon-containing solids 600°C.
5399	2/5/29	Fr 689,274 Brit 339,681	Separating of coal-oil mixtures such as pressure hydrogenation residues by filtration at higher temperature and by distillation or extraction.
5432	2/21/29	Fr 689,274 Brit 339,681	Separation of coal-oil mixtures by filtration through a fine mesh screen and distillation.
5540	4/22/29	Brit 338,154	Separation of solids from oils with flocculating gaseous acid substances.
5733	7/17/29	Germ 595,348 Fr 698,425 Brit 341,451	Improving the separation property of hydrogenation residue by longer heating.
5907	10/3/29	Fr 700,741 US 1,993,226	Separating the tars and dust or other solid constituents by the addition of flocculating solid or liquid hydrocarbons, in particularly those rich in hydrogen.
6109	1/17/30	Germ 677,647 Fr 708,809 Brit 360,424	Fractionating pressure release of the reaction products condensed under pressure.
6457	5/26/30	Germ 591,729 Fr 716,703 Brit 365,046 US 2,060,447	Working up of asphaltic materials such as tars and coal hydrogenation residues by fractionating precipitation of asphalt with precipitants.
6726	9/27/30	Fr 724,376	The use of tubular bundle rotating furnaces for the thermal treatment of solid or pasty materials.

The I.G. Serial Number O.Z.	Date	Patent		
6846	12/6/30	Germ Fr	577,338 726,128	Continuous distillation of hydrogenation products in vertical columns provided with plates and/or filler bodies.
6945	2/9/31	Germ Fr Brit	672,610 731,143 384,704	Treating of mixtures of solids and liq uids in tubular bundles in rigid arrangement at accurately maintained definite temperatures.
7030	3/20/31	Germ Fr	682,244 726,346	Production of a stabilized gasoline by separation of the light boiling constituents and of the light gasoline by distillation, recovery of the light gasoline by washing with oil under pressure or by adsorption on porous masses, stabilizing the light gasoline by pressure distillation and blending the stabilized light gasoline with the heavy gasoline fractions.
7070	4/22/31	Brit	391,283	Washing the hydrogenation products obtained with alkaline solutions under pressure before their contact with air.
7662	8/12/32	Germ Fr Brit	654,265 759,691 409,278	Stage-wise precipitation of asphalts with liquefied hydrocarbons.
7913	3/24/33	Germ Fr Brit	659,924 770,202 422,742	Working up of the residues of pressure hydrogenation by mixing warm with the addition of dilute acids or solutions of acid salts for the separation of oils from solids and asphalts and the separation of the oils.
7949	4/29/33	Germ Fr Brit	630,965 770,202 417,757	Separation of residues of pressure hydrogenation by the stage-wise centrifuging with the addition of thinners.
7966	5/18/33	Germ Fr	656,364 770,202	Pressure hydrogenation of coal pasted with oil in the presence of finely divided catalysts under such conditions that the solid constituents in the residues have uniformly small particle size. Centrifuging the residues.

The I.G. Serial Number O.Z.	Date	Patent	
8207	12/22/33	Fr 781,543 Fr 45,561 Brit 435,254 US 2,216,130 US 2,216,131 US 2,216,132	Withdrawal of the freshly distilled pressure hydrogenation products from the effect of air and storing them under an inert gas for further working up.
8434	6/29/34	Germ 683,919 Fr 791,698 Brit 445,898	Enriching the solids in the hydrogenation residues by the addition of hydrocarbons boiling below 100°C in such amounts that all the solids and only a fraction of the asphalts are precipitated.
8448	7/10/34	Fr 791,604 Brit 443,601	Separation of solids from liquids. The mixture passes through several chambers with successively lower levels of the liquid entering each chamber in a thin layer from a drain coming from the bottom of the preceeding chamber through an overflow reaching into the next chamber.
8616	11/9/34	Germ 711,559 Fr 797,289 Brit 450,107 US 2,144,409	Separation of solids from oils by treating with aliphatic hydrocarbons with 6 - 10 C atoms near their critical temperature (heptane).
8798	3/15/35	Fr 804,094 Brit 454,132	Working up of the residues by heating in the presence of liquid metals or of metal alloys.
8903	6/5/35	Germ 669,662 Fr 805,889 Brit 463,961	Stabilization of pressure hydrogenation gasolines.
9165	12/20/35	Germ 699,707 Fr 813,845 Brit 469,036	Working up of hydrogenation residues by heating in ball furnaces in a current of flushing gases and distilling off the oil.
9408	6/6/36	Fr 814,699 Brit 470,072	Stabilization of hydrogenation residues or of pressure extracts by the addition of small amounts of organic compounds of high molecular weight such as oxy compounds, sulfur compounds or metallo organic.

The I.G. Serial Number O.Z.	Date	Patent		
9408				compounds which repress polymerization and oxidation.
9497	7/22/36	Fr	824,436	De-asphaltizing products from the brown coal by treating with light hydrocarbons (propane and de-paraffining them with organic oxygen-containing thinners at low temperatures.
9742	1/9/37	Germ	720,825	Use of part of the pressure hydrogenation products for pasting of the feed, working up the rest for fuel oil, lubricating oil or motor fuel.
		Fr	50,268	
		Fr	831,060	
		Brit	510,743	
9745	1/11/37	Germ	679,371	Pressure hydrogenation in the presence of iron-containing masses. Working up of the solid residues by metallurgical methods for the recovery of iron.
		Fr	831,384	
		Brit	509,024	
10185	8/25/37	Fr	842,544	Working up of the residues in a rotary furnace with filling elements. The use of hollow filling elements filled with substances of lower specific weight.
		Brit	504,349	
10408	2/17/37	Germ	698,794	Addition of acid to hydrogenation residues kneading with equal amounts of ground coal, separating water and ash and pressure hydrogenating.
10481	1/20/38	Germ	705,448	The separation of hydrogenation residues, into solids and oil by filtration after treating with gaseous halogen compounds or with aluminum chloride.
10523	2/8/38			Recovery of vanadium from petroleum hydrogenation residues by heating the oil-free residues to temperatures over 1200°C.
11184	12/7/38	Germ	712,255	Injection of a scrubber oil into the gases leaving the reaction space and consisting of hydrocarbons and hydrogen, immediately upon their leaving the reaction space, and introducing the scrubber oil with the gas into the scrubber tower.

The I.G. Serial Number O.Z.	Date	Patent		
11216	12/21/38	Germ	729,490	Addition of hydrogen-rich hydrocarbons at elevated temperatures to high boiling pressure hydrogenation products, freeing the mixture from solid constituents and separating into hydrogen-poor and hydrogen -rich layers by lowering the temperature and/or the addition of low molecular hydrocarbons or selective solvents. The use of hydrogen-poor layer as a pasting oil.
11340 12198	2/4/39	Fr	887,037	Working up of hydrogenation residues by filtration or centrifuging after previous oxidation, dehydrogenation and/or sulfurizing.
12145	5/15/40	Germ Fr	727,112 887,090	Working up the pressure hydrogenation residues by heating with thinners in a water solution of sulfonated olefins with about 10 - 20 C atoms per mol or their salts at elevated pressures and temperatures exceeding 180°C to the formation of layers.
12198	2/4/39	Germ Fr	712,230 887,037	See O.Z. 11340
13122	11/26/41	Germ	752,699	Filtration of the hydrogenation residues with the addition of alcohols boiling over 100°C as thinners.
13129	12/1/41	Germ Fr	753,562 887,958	Filtration of the pressure hydrogenation residues after the addition of thickened sulfite liquor.
13171	12/27/41			The separation of solids from hydrogenation residues after thinning with the addition at thinners of aldehydes, carboxy acids, their esters, or halides with a boiling point between 40 - 200°C.
13899	12/27/41			See O.Z. 13171
14018	2/24/43			Working up of hydrogenation residues by heating with water under pressure, so that water is present in the form of steam. Cooling until water is condensed and separating the three layers formed.

The I.G. Serial Number O.Z.	Date	Patent	
14378	8/28/43		Working up the hydrogenation residues by breaking down the HOLD into parts of about equal compositions. Topping of one part for briquetting pitch and centrifuging the other part after the addition of hydrogenation heavy oil and middle oil, a low temperature carbonization of the centrifuge residue and the use of the oil residue from topping, centrifuging or low temperature carbonization for pasting of coal.
14496 14503	12/6/43 12/10/43		Fuel oil consisting of hydrocarbons obtained together with the phenols by extraction of hydrogenation oils or tars with selective solvents and then separated from the extracted phenols. The use of this fuel oil in mixture with others of a higher pour point or with asphaltic materials or with oils containing asphalts.
14610	2/25/44		The use of de-oiled residues of coal liquefaction by increasing the carbon content to at least 40%, briquetting and working up the briquettes with oxygen and steam to water gas.

d) Uses for Hydrogenation Products

3274	9/1/25	Fr 619,274 Brit 257,906 US 1,818,158	The use of hydrogenation oils as a scrubbing means for benzol-containing gases.
3306	10/19/25	Fr 620,633 Brit 278,341	Gasoline with pressure hydrogenation-gasoline addition.
3321	11/4/25	Fr 620,633 Brit 278,341	Pressure hydrogenation gasoline mixed with alcohol and if necessary with gasoline of other origin.

The IG. Serial Number O.Z.	Date	Patent	
~~3324~~	~~11/9/25~~	~~Fr 623,964~~ Brit 261,039 Brit 287,114 Brit 287,115 Brit 287,116 US 1,876,009 US 1,890,434 US 1,931,549 US 2,005,192 US 1,931,550 US 1,983,234 US 1,996,009 US 2,006,996 US 1,994,075	~~The use of pressure hydrogenation products as solvents and cleansing agents.~~
4173	5/31/27	Germ 516,316 Fr 668,102 Brit 305,553	The voltolization of pressure hydrogenation products and their use as lubricating and insulating oils.
4707	3/16/28	Brit 330,593	Pressure hydrogenation gasoline with the addition of petroleum casing head gasoline.
4829	5/21/28	Fr 674,456 Brit 325,858 US 1,910,051	Blending of low boiling knocking with high boiling anti knock gasoline fractions.
5249	12/1/28	Fr 37,662 Fr 620,633 Brit 333,224	Gasolines with the addition of pressure hydrogenation products from bituminous coal with a boiling point over 100°C.
5412	2/9/29	Germ 558,638 Fr 689,625 Brit 339,636 US 1,945,583	Hydrogenation or cracking residues as filtering material for the separation of finely divided impurities from liquids.
5530	3/31/27	Fr 650,975 Brit 288,148 US 1,927,244	The production of activated charcoal by careful heating of de-oiled hydrogenation residues in the presence of additions.
6552	7/4/30	Germ 600,705 Fr 718,372 Brit 363,105	Preventing the caking of coal by the addition of hydrogenation residues.
6623	8/14/30	Fr 718,504	Pressure hydrogenation gasolines containing but a small proportion boiling below 100°C with hydrocarbons obtained by pressure hydrogenation and boiling below 100°C.

The I.G. Serial Number O.Z.	Date	Patent	
7894	3/9/33	Fr 765,114 Brit 418,941	Gasoline with a tendency to ping to be mixed with a gasoline obtained by refining hydrogenation.
8310	3/16/34	Fr 787,374	Production of artificial gums by the polymerization of liquid hydrocarbons obtained by cracking of pressure hydrogenatdn products, using catalysts of the Friedel-Crafts synthesis.
8327	3/20/34	Germ 631,468 Fr 787,801 Brit 434,295 US 2,104,097	The use of the vacuum residue of the de-asphaltized hydrogenation products, in particular from coal, as lubricating oil dyes.
8384	5/30/34	Fr 789,993 Brit 441,878 US 2,108,901	The production of wetting, washing and dispersing media by the sulfonation of the hydrogenation products of bituminous coal or of the tar.
8557	9/26/34	Fr 795,364 Brit 452,917	Gasoline obtained from bituminous coal under strongly hydrogenating conditions mixed with metal-containing anti-knock agents.
8746	2/7/35	Fr 799,018	The use of coal hydrogenation residues mixed with coal as a fuel for oil firing.
8761	2/21/35	Fr 801,354 Brit 450,789	The use of hydrogenating tar oils or mineral oils as extraction media for the production of phenols from off-waters.
9162	12/18/35	Germ 688,371 Fr 814,699 Brit 470,072	The use of semi-solid or solid oils made thin-flowing by heating, with the addition of substances obtained by polymerization, condensation or oxidation, as lubricants for heavy oil motors.
9169	12/21/35	Germ 693,853 Fr 814,170 Brit 473,882	The use of semi-solid or solid oils for lubricating of heavy oil motors, were only a small amount made thin-flowing by heating.
9229	2/7/36	Germ 669,582 Fr 816,767 Brit 475,496	The use of gas oil for starting the heavy oil motors, then changing them over to high boiling pressure hydrogenation or extraction products.

The I.G. Serial Number O.Z.	Date	Patent	
~~10177~~ 12345 12707	~~8/20/37~~	Germ 746,083	The use of the residues of coal extract hydrogenation as plasticizers, for impregnation and as fillers in rubber-like masses.
10458	7/10/37	Fr 838,430	The production of aviation gasoline from gasolines containing aromatic hydrocarbons by decomposition with selective solvents and liquefied hydrocarbons and the addition of raffinates containing liquid non-aromatic compounds, which impart a higher octane number to the mixture than 75.
10607	3/10/38	Germ 764,174 Fr 887,089	The production of plastic masses from hydrogenation residues with the use of polymerization agents.
10787	7/15/36	Germ 699,723 Fr 824,292 Brit 499,378 US 2,213,407	Increasing the ignitability of oils of low reactivity by treatment with oxygen.
10826	5/20/36	Austr 160,704 Fr 819,659 Brit 482,783	The use of a mixture of coal hydrogenation oils with hydrogen-rich oils as diesel oil, with the hydrogen-poor oils being dehydrogenated with oxidizing substances before blending.
10828	7/23/36	Germ 704,195 Fr 48,640 Fr 819,659 Brit 490,094	See O.Z. 10826
12080	3/30/40		Gasoline with the addition of alkyl benzols containing at least 5% di-ethyl benzol or alkyl propyl benzol.
12422	10/30/40		Aromatic pressure hydrogenation gasolines with 5 - 40% methyl ethyl benzol.
12345			See O.Z. 10177
12354	9/19/40		Impregnation of textiles with high boiling pressure hydrogenation products of coal or its distillation or extraction products.

The I.G. Serial Number O.Z.	Date	Patent	
12525	1/2/41		Breaking down cyclic hydrocarbon-containing gasolines, alkylation of the fraction boiling below 130°C and blending with the fraction boiling above 130°C.
12707			See O.Z. 10177
12810	5/31/41		Pressure hydrogenation gasoline which contains 30 - 70% of aromatic hydrocarbons in addition to 5 - 40% of ethyl or propyl benzol.
12914	7/24/41		Improving leaded gasoline by the addition of aliphatic alcohols, aldehydes, ketones or lactone with at least 4 C atoms.
13187	8/27/40	Germ 742,518	The use of gums from low temperature carbonization tar or from pressure extracts or from pressure hydrogenation products as a base for lacquers and insulators.
13836	12/11/42		Safety fuel from hydrocarbon mixtures with an octane number of at least 65 and 5 - 50% of di or tri propyl benzol, propyl butyl benzol or di propyl benzol.
13917	1/15/43		Improving leaded gasoline by the addition of 0.001 to 1% of a fraction of a pressure hydrogenation products boiling between 160 and 250°C.
14153	5/6/43		Paraffinic hydrogenation gasolines with an octane number of over 55, with the addition of at least 5% alkyl benzol with at least one side chain with more than one C atom and a boiling point not over 250°C.
14516	12/16/43		Gasoline with an octane number of 70 and over, and 10 - 30% of different alkyl benzols.

The I.G. Serial Number O.Z.	Date	Patent		
e) Production of Low Boiling Aromatics				
8907	6/8/35	Germ	713,952	The separation of low boiling aromatic hydrocarbons from hydrogenation products by treating with liquefied hydrocarbons which are gaseous at room temperatures, and liquid sulfur dioxide at low temperatures of -20°C and lower.
		Fr	808,534	
		Brit	459,189	
9841	3/5/37	Fr	833,153	Separation of xylol and ethyl benzol from low boiling hydrocarbon mixtures by the production of a fraction enriched in xylol and ethyl benzol, and separating this fraction by freezing.
9881	3/24/37	Germ	721,221	See O.Z. 8907
		Fr	49,244	
		Fr	808,534	
9884	3/25/37	Fr	49,244	See O.Z. 8907
		Fr	808,534	
9957	1/18/37	Fr	830,879	See O.Z. 8907
10091	4/21/37	Fr	836,823	The separation of aromatic hydrocarbons from bituminous coal hydrogenation gasoline by extraction with selective solvents and liquefied gaseous hydrocarbons, dehydrogenation of the hydrogen-rich fraction and extracttion of the newly formed aromatic hydrocarbons.
f) The Production of Uniform Polynuclear Compounds				
5162	10/24/28	Fr	687,957	The production of carbazol and carbazol-containing tar fractions by catalytic pressure hydrogenation and their separation.
		Brit	340,585	
8164	11/23/33	Germ	639,240	Thinning high boiling pressure hydrogenation products of bituminous substances with hydrogen-rich hydrocarbons and addition of dilute acids and separation of the polynuclear compounds by crystallization.
		Fr	781,543	
		Brit	435,254	
		US	2,216,131	
		US	2,216,132	
8165	11/23/33	Germ	654,082	Dehydrogenation of pressure hydrogenation products, separation of the polynuclear compounds by physical or chemical means.
9400		Fr	45,561	
		Fr	781,543	
		Brit	435,254	

The I.G. Serial Number O.Z.	Date	Patent	
8208 10279	12/22/33	Fr 45,561 Fr 781,543 Brit 435,254 US 2,216,131 US 2,216,132	Catalytic isomerization of cyclic hydrocarbon-containing products and dehydrogenation of the resulting products, separation of the polynuclear compounds.
8218	12/28/33	Germ 640,580 Fr 781,543 Brit 435,254 US 2,216,131 US 2,216,132	Separation of asphalts from high boiling hydrogenation products by solvents, precipitation or adsorption means, distillation of the separated substances and the production of uniform compounds from the distillates.
8219	12/28/33	Germ 695,861 Fr 45,561 Fr 781,543 Brit 435,254 US 2,216,131 US 2,216,132	The production of polynuclear compounds from pressure hydrogenation products of other bituminous substances than the bituminous high temperature tars.
8266	1/31/34	Germ 699,304 Fr 45,561 Fr 781,543 Brit 435,254 US 2,216,131 US 2,216,132	The polymerization compounds from pressure hydrogenation products of bituminous material are separated from the asphalts, gums, and paraffins and distilled with the addition of metals, or condensation dehydrogenation prior to, during, or after the distillation.
8267	1/31/34	Germ 655,103 Fr 45,561 Fr 781,543 Brit 435,254 US 2,216,131 US 2,216,132	Freeing pressure hydrogenation products from paraffins and asphalts, separating the polynuclear compounds, if necessary after dehydrogenation.
8268	1/31/34	Germ 699,303 Fr 45,561 Fr 781,543 Brit 435,254 US 2,216,131 US 2,216,132	Purification of high boiling fractions of bituminous coal tar or hydrogenation products from bituminous coal or tars, or their dehydrogenation products with absorption or condensation agents, the separation of polynuclear compounds.
8275	2/8/34	Germ 639,241 Fr 45,561 Fr 781,543	Freeing asphalt-containing oils from asphalt, pressure hydrogenating the oils, dehydrogenation if necessary of hydrogenation

The I.G. Serial Number O.Z.	Date	Patent	
8275	2/8/34	Brit 435,254 US 2,216,131 US 2,216,132	products and separation of polynuclear compounds.
8329	3/31/34	Germ 659,878 Fr 781,543 Fr 45,561 Brit 435,254 US 2,216,131 US 2,216,132	The production of polynuclear compounds from pressure hydrogenation products obtained from bituminous coal at below 440°C with such a thruput that the gasification amounts to less than 13% and with such concentration of catalysts that the heavy oils contain less than 5% asphalt.
8335	4/5/34	Germ 654,201 Fr 45,561 Fr 781,543 Brit 435,254 US 2,216,131 US 2,216,132	Dehydrogenation of pressure hydrogenation products, the separation of polynuclear compounds, and their catalytic hydrogenation.
8364	5/2/34	Germ 668,966 Fr 45,561 Fr 781,543 Brit 435,254 US 2,216,131 US 2,216,132	Dehydrogenation of pressure hydrogenation products of bituminous substances under a reduced pressure and if necessary with metals of the III-VIII groups or their compounds, separation of the polynuclear compounds.
8658	12/8/34	Germ 696,867 Fr 46,816 Fr 781,543 Brit 435,254	Dehydrogenation of the hydrogenation products in the presence of metals of the platinum group and separation of polynuclear compounds.
9149	12/12/35	Germ 724,162 Fr 814,169 Brit 468,375 US 2,132,193	Production of partially hydrogenated polynuclear compounds by treating in alkaline solutions the aromatic and heterocyclic compounds containing at least one oxy group-free ring with hydrogen under pressure in presence of catalysts.
9207 9894	1/24/36	Germ 699,306 Fr 816,162 Brit 470,338 US 2,190,191	Production of mono and di methyl pyrene or 1,12 benzo perylene, or coronene from pressure hydrogenation products of bituminous coal, or coal extract; centrifuging the oils, distillation of the residue and separation of the polynuclear compounds from the distillate.

The I.G. Serial Number O.Z.	Date	Patent	
9265	5/26/36	Germ 726,546 Fr 816,162 Brit 470,338 US 2,190,191	Performing the distillation according to O.Z. 9207 with a supply of small amounts of oxygen.
9400		Germ 673,378	See O.Z. 8165
9830	2/27/37	Germ 699,307 Fr 834,062 Brit 493,447 US 2,241,410	Production of polynuclear compounds from extracts by splitting without appreciable hydrogenation, and the separation of the polynuclear compounds.
9888	3/27/37	Germ 700,433 Fr 49,191 Fr 813,846 Brit 493,307	The separation of liquefaction products from pressure extracts or obtained by mild pressure hydrogenation by treating with hydrocarbons (C_4- C_9), separating the heavy oils, separating the polynuclear compounds from the latter, if necessary after the dehydrogenation.
9889	3/27/37	Germ 701,418 Brit 493,508	Breaking down extracts with selective solvents, pressure hydrogenation and/or dehydrogenation of the hydrogen-poor fractions. Separating the polynuclear compounds from the reaction powder.
9894	4/1/37	Germ 754,618 Fr 49,332 Fr 816,162 Brit 497,089	See O.Z. 9207
10279			See O.Z. 8208
10456 11322	1/6/38	Germ 763,621 Fr 50,087 Fr 816,162	The production of polynuclear compounds, like coronene, from cracking residues or from the products from brown coal, in particular pressure hydrogenation products.
10533	2/10/38	Germ 695,329 Brit 510,736	Coronene from pressure hydrogenation products of bituminous coal pitch by precipitation of asphaltic materials, their direct distillation or extraction with solvents.
11322	1/6/38	Germ 764,528	See O.Z. 10456

The I.G. Serial Number O.Z.	Date	Patent	
12702	4/9/41	Germ 741,343	The production of phosphorescent materials by the introduction of partially hydrogenated coronene into solid polynuclear fully hydrogenated hydrocarbons.

g) Production of Phenols

2700	7/27/23	Germ 420,393	Phenols from phenol homologs with hydrogen at elevated temperatures.
8381	5/25/34	Fr 790,499	Production of phenols from pressure hydrogenation products of coal with the addition of metals of the II toIV groups or of manganese, or iron or their compounds and if necessary of acids and acid salts.
9862	3/16/37	Germ 670,356 Fr 833,152 Brit 491,320	Production of phenols from hydrogenation oils by extraction of the sulfide of the alkali or alkaline earth metals with solvents.
11438	3/20/39	Germ 764,490	Production of phenols by extraction of oils with water and de-phenolating the enriched waters which are to be re-used for extraction.
13151	12/7/41	Germ 753,953	Production of phenols from bituminous coal low temperature carbonization tar by protective pressure hydrogenation during which the high molecular weight phenols are converted into low molecular weight phenols.
14004 14163 14625 14644	2/20/43		Separation of phenols from oils by treating with liquefied ammonia and selective solvents which dissolve the neutral oils well and dissolves at phenols poorly
14163	5/11/43		See O.Z. 14004
14241	6/17/43		De-alkylation of the higher phenols by the mild hydrogenation in the liquid phase with the addition of coal and/or tar.
14625	2/28/44		See O.Z. 14004

The I.G. Serial Number O.Z.	Date	Patent	
14644	3/9/44		See O.Z. 14004
14746	5/17/44		Separation of phenols from hydrogenation oils by extraction with selective solvents (NH_3) and treating the extract with gasoline (boiling point 60 - 100°C) and treating the phenol-containing layer with acid.
14770	6/2/44		Extraction of phenols from oils with formamid.
15000	11/2/44		The production of monovalent phenols from polyvalent phenols by evaporation with hydrogen used in hydrogenation and leading the mixture over catalysts, drawing off of the non vaporized portions of the feed from the bottom part of the vaporizer.

The I.G. Serial Number O.Z.	Date	Patent	
IV. Combination Processes			
a) Hydrogenation and Cracking			
4333	9/1/27	Fr 659,583 Brit 296,429 US 1,932,174	Freeing oils and tars by pressure hydrogenation from sulfur and oxygen compounds and then cracking.
4337	9/5/27	Fr 659,906 Brit 296,760	Cracking of high boiling oils with the separation of coal and then pressure hydrogenating.
4880	6/15/28	Germ 669,804 Fr 36,011 Fr 659,583 Brit 328,618 US 1,917,324	Pressure hydrogenation of the raw materials to hydrogen-rich products, cracking these middle oils.
4940	7/13/28	Fr 37,191 Fr 659,906 Brit 335,522 US 2,045,794	Cracking of high boiling hydrocarbons without separation of coal and with limited gasoline formation and pressure hydrogenation of the higher boiling parts.
7642	7/26/32	Fr 749,843 Brit 418,926	Refining pressure hydrogenation of gasoline, followed by heating to high temperatures.
7893	3/8/33	Fr 769,587 Brit 420,235	Splitting above 400°C the mixtures of strongly hydrogenated oils or paraffin-base oils with cracking products, asphalt-base oils or tar oils with the addition of small amounts of finely divided catalysts.
8290	3/3/34	Germ 686,758 Fr 786,145 Brit 439,314	Pressure hydrogenation of middle oils with strongly hydrogenating catalysts, moderate splitting of the portions boiling above 125°C.
8579	10/13/34	Fr 795,988	Cracking of middle oils, polymerizing the olefin-rich splitting gases to liquid hydrocarbons, pressure hydrogenating the splitting residues.
10059	6/19/37	Germ 700,435	Splitting of the lighter fractions of asphalt-base petroleum oils in such a way that a residue is formed of a specific gravity of over

The I.G, Serial Number O.Z.	Date	Patent	
10196	8/28/37	Germ 762,966 Fr 842,187 Brit 507,999 US 2,245,157	The addition of low boiling aromatic or hydro-aromatic hydrocarbons during the cracking in the vapor phase of paraffinic pressure hydrogenation products for the production of anti-knock fuels.
10364	11/27/37	Germ 725,601	Cracking of middle oil, pressure hydrogenation of heavy oil and the cracked middle oil and catalytic cracking of pressure hydrogenation middle oil.
11525	5/9/39	Germ 764,444 Fr 887,263	Production of anti-knock fuels by breaking down the feed into mixtures of paraffinic and naphthenic hydrocarbons, splitting the paraffinic hydrocarbons, mixing both reaction products.
12838	6/23/41		Splitting of hydrocarbons, alkylation of the low boiling splitting products and hydrogenation of the higher boiling products.
14763	6/2/44		The production of anti-knock gasolines of the proper boiling range by splitting heavy gasolines in presence of active silicates or alumina, further splitting of the higher boiling reaction products and then pressure hydrogenating over active alumina + the oxides or the fluorides of the metals of the V and/or VI groups, and mixing the gasoline obtained with the splitting gasoline.

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V. Industrial

a) Construction Materials

3104	3/13/25	Fr 612,503 Brit 249,155 Brit 277,273	Exclusion of free iron, nickel, cobalt and use of copper, silver, aluminum or alloy steels containing manganese, titanium, chromium tungsten, vanadium, molybdenum or of analogous alloys or of chromium, manganese, vanadium, uranium as material for the internal parts of pressure hydrogenation equipment. The use of tin, zinc, cadmium, lead or their alloys for the cooler parts of the equipment.
3277	9/2/25	Fr 612,503 US 1,876,009 US 1,890,434 US 1,931,549 US 2,005,192 US 1,931,550 US 1,983,234 US 1,996,009 US 2,006,996 US 1,994,075	Pressure hydrogenation equipment made from chromium or chromium alloys.
3279	9/2/25	Germ 655,324 Fr 612,503 US 1,876,009 US 1,890,434 US 1,931,549 US 2,005,192 US 1,931,550 US 1,983,234 US 1,996,009 US 2,006,996 US 1,994,075	Pressure hydrogenation in equipment of special alloys containing over 10% chromium and less than 0.2% carbon, and if necessary nickel.
3323	11/6/25	Fr 612,503 Brit 249,155 Brit 177,273 US 1,904,476	Pressure hydrogenation using equipment clad with aluminum.

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3514	4/1/26	Fr 632,850 Brit 268,796 US 1,922,491	Conversion of tars, mineral oils, and asphalts with hydrogen under pressure into low boiling products in the absence of metals which favor the deposition of carbon. Carrying out the reaction in the presence of cobalt, nickel, molybdenum, chromium, tungsten, manganese, titanium, zirconium, columbium, tantalum, thorium, uranium, copper and their alloys, e.g. cladding of the reaction vessels.
3551	5/1/26	Germ 578,504 Fr 632,850 Brit 270,313 US 1,922,491	See O.Z. 3514
3552	5/1/26	Fr 632,850 Brit 270,314 US 1,922,491	See O.Z. 3514
3557	5/5/26	Fr 632,850 Brit 270,698 US 1,922,491	See O.Z. 3514
3564	5/7/26	Fr 632,850 US 1,922,491	See O.Z. 3514
3565	5/7/26	Fr 632,850 Brit 270,704 US 1,922,491	See O.Z. 3514
3573	5/20/26	Fr 632,850 Brit 271,451 US 1,922,491	See O.Z. 3514
3671	7/16/26	Fr 632,850 US 1,922,491	See O.Z. 3514
3698	8/7/26	Fr 33,955 Fr 632,850 Brit 275,662 US 1,835,425 US 1,835,426	Pressure hydrogenation in presence of such construction materials which do not favor the formation of carbon and of methane, e.g. alloy steels, containing cobalt, molybdenum, tungsten, vanadium, and/or manganese;

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3698	8/7/26	Fr 33,955 Fr 632,850 Brit 275,662 US 1,835,425 US 1,835,426	introduction of non-metals like boron, arsenic, antimony or silicon into construction materials.
3892	12/20/26	Fr 34,590 Fr 612,503 Brit 282,384	The use of low carbon steels, e.g. chromium-nickel steels (V2A, or WT_2 of Krupp) as construction material for the equipment of pressure hydrogenation.
3892B	5/21/28	Fr 35,831 Fr 612,503 Brit 311,628	Cladding of the apparatus with silver, even in the presence of sulfur.
4328	8/30/27	Fr 659,582 Brit 309,057 US 1,894,116	Carrying out reactions under high pressure in double walled vessels, of which at least one wall is made of alloy steel.
5688	6/27/29	Germ 533,407 Fr 697,539 Brit 341,153 US 1,949,109	Pressure hydrogenation apparatus consisting of or coated with copper-zinc alloys and their compounds as catalysts.
5965	11/2/29	Germ 637,237 Fr 39,175 Fr 697,539 Brit 341,153 US 1,949,109	Zinc alloys with a melting point over 500°C except copper-zinc alloys as material for the pressure hydrogenation equipment.
6015	12/3/29	Germ 626,461 Fr 705,406 Brit 365,619 US 1,969,422	Equipment coming in contact with sulfur-containing reactants made of hydrogen-resistant material and provided with a sulfur resistant coating.
6186	2/8/30	Fr 710,660 Brit 361,856	The use of chromium and molybdenum -containing alloys as construction materials for the pressure hydrogenation apparatus.
6587	7/24/30	Germ 709,215 Fr 719,327	High pressure apparatus made of a titanium-containing alloy, or

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6587	7/24/30	Brit 366,762 US 1,995,647	coated with such.
7457	2/19/32	Germ 590,874 Fr 750,869 Brit 422,273 US 2,063,596	Coating of apparatus obtained by the decomposition of volatile metal compounds, in particular such containing carbon.
7505	3/22/32	Germ 590,875 Fr 757,433 Brit 403,647 US 2,056,914	Coating of apparatus with the high melting elements of the IV group in particular silicon or titanium by impregnation of the surface with powder of this element at high temperatures.
8161	11/18/33	Fr 780,050 Fr 45,761 Brit 445,274 Brit 453,419 US 2,068,868	Pressure hydrogenation in the presence of volatile halogen (chlorine) compounds using silver clad equipment.
8420	6/19/34	Fr 775,202 Brit 434,624	Zinc coating the apparatus for the pressure hydrogenation by means of zinc vapors.
8494	8/3/34	Germ 661,489 Fr 792,918	Iron or iron alloys coated by diffusion with a zinc, antimony and/or manganese alloy as material for pressure hydrogenation apparatus.
8688	12/21/34	Fr 800,957 Brit 458,667	Pressure hydrogenation apparatus of hydrogen-resistant material coated on the inside with cadmium or cadmium alloys.
8979	7/30/35	Fr 811,064 Brit 461,251	Alloy steel for highly heated parts of apparatus consisting of: carbon 0.06-0.2%; chromium 1.5-3%, molybdenum 0.3-0.6%, tungsten 0.3-0.6%, with the balance iron, together with some silicon, manganese, copper and possibly other constituents.

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9088	11/8/35	Germ	756,064	Apparatus of chromium steel with a silicon content in excess of 1%.
		Fr	811,991	
		Brit	469,101	
		US	2,147,838	
9763	1/20/37	Germ	746,223	Pressure gauge tubes for high pressures made be cold working from a soft annealed carbon steel containing less than 0.6% carbon.
9968 13332	8/23/40	Fr	845,601	Interchangeable arrangement of the return and connecting pieces made from an erosion proof material.
12508	12/20/40	Germ	758,944	A high pressure vessel consisting of an inner hollow body of ceramic material and an outer pressure carrying wall, the intermediate layer filled in with cast metal.
13332		Fr	892,929	See O.Z. 9968

a1) Arrangement of the Equipment

2109		Germ	290,877	Apparatus for hydrogenation reactions consisting of an inner and an outer vessel, with the space in between filled with a material impervious to hydrogen and not reacting with it.
2969	11/7/24	Germ	445,107	Introduction of solid material in the reaction vessels under pressure by having the solids in a granular or finely powdered form pressed in into the pressure space through a cylindrical or conical tube in such a way that the substance itself will tighten the opening.
		Fr	606,416	
		Brit	262,904	
		Brit	268,188	
2986	12/2/24	Fr	608,515	Removal of reaction products or residues from reaction vessels under pressure by leading the

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2986	12/2/24	Fr 608,515	substances into a receiver connected with the reaction vessel and kept under the same pressure, and discharged from there under no pressure.
3022	1/5/25	Germ 449,686 Fr 606,416 Brit 262,901 Brit 268,188	The process O.Z. 2969 used for the removal of solids from the pressure vessels.
3109	3/16/25	Germ 454,576	Filling with and discharging solids. The solids are pasted with a liquid which evaporates during the filling or discharging while the solids remain.
3181	5/16/25	Germ 432,848	Mixing the feed in a finely powdered form with the hydrogenation gas and compressing it to somewhat above the reaction pressure, permitting the mixture to enter the reaction space through valves.
3662	7/11/26	Germ 541,820 Fr 637,386 Brit 274,122	Introduction of solids into the high pressure space after passing through a space brought to the same pressure.
4445	11/24/27	Fr 664,375 Brit 301,059 US 1,890,437	The use of several reaction vessels in series during the pressure hydrogenation.
4836	5/24/28	Fr 674,457 Brit 317,996	The addition of substances liquid at the operating temperature for the production of a liquid skin as a protection for the construction material in vapor phase reactions.
4880	5/25/28	Germ 669,804 Fr 36,011 Fr 659,583 Brit 328,618 US 1,917,324	Inclusion of a catchpot after the reaction vessel the vapors being removed in such a way that sufficient liquid remains for the let down of solids.

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~~5145~~	~~10/19/28~~	~~Germ~~	~~562,495~~	~~Pressure hydrogenation in an~~
5370		Fr	683,300	inclined rotating tube bundle
		Brit	329,957	furnace, with the tube bundle opening inserted into a bin filled with the feed.
5370	10/19/28	Germ	565,410	See O.Z. 5145
5572	5/8/29	Germ	506,240	An arrangement for the recovery
		Fr	693,852	of energy required to bring a
		Brit	344,842	liquid under high pressure.
		US	1,909,145	Transfer of the pressure of this liquid directly to a second liquid by means of a piston or a diaphragm.
5912	10/5/29	Fr	702,439	The feed is floated on the surface
		US	1,865,183	of a liquid medium which does not participate in the reaction.
6064	12/23/29	Fr	702,439	See O.Z. 5912
		US	1,865,183	
6071	12/27/29	Fr	708,201	See O.Z. 5912
6094	1/11/30	Germ	526,231	A conical valve seat closed by a
		Fr	707,275	conical valve body for tightening up against high pressures.
6129	1/21/30	Fr	708,201	Continuous treating of solids under pressure in thin layers on intermittently moving supports.
6152	1/29/30	Brit	360,943	The introduction and removal of
7676				solids into and out of pressure vessels through several interconnected spaces with a step-wise increase or reduction of the pressure.
6153	1/29/30	Fr	707,276	Carrying out of solids from high pressure spaces with a conical screw conveyer to which a liquid is being fed.

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6167	2/4/30	Germ Fr	545,711 709,951	Introduction and removal of solids into and out of a high pressure space with the liquid formed during the reaction being used as the displacing liquid.
6246	3/5/30	Germ Fr Brit	583,789 712,617 363,626	Pressure hydrogenation converters with perforated trays arranged above each other.
6345	4/12/30	Fr	713,583	Pressure hydrogenation of coal in thin layers on supports with a continuous forward motion.
6419	5/10/30	Fr Brit	715,894 364,665	Pressure hydrogenation of coal in thin continuously rolled layers in rotating tubes.
6485	6/7/30	Fr	717,057	The removal of catalyst poisons from pressure vessels by treating with hydrogen under pressure.
6652	8/28/30	Fr Brit	718,705 364,665	Hydrogenation in tubes rotating along their longitudinal axis.
6676	9/4/30	Fr	718,705	Catalyst on movable supports carried through the converter.
6921	1/21/31	Germ Fr	596,870 721,830	The tube insets for the supply and removal of feed made of heat and corrosion resistant material and thermally insulated from the body of the vessel and connected with the vessel and the piping in such a way that there is a temperature gradient between the highly heated parts of the pipe line and the vessel material.
6945	2/10/31	Germ Fr Brit	672,610 731,143 384,704	Pressure hydrogenation of pasted coal in rigidly arranged tube bundles used as the reaction space.

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6998	3/12/31	Fr	732,957	The tightening of closures with an elastic material like rubber.
7041	4/4/31	Fr	742,631	Pressure hydrogenation in tube bundles arranged in a pressure resistant container, the tubes themselves not being built to withstand the high pressure.
7092	5/11/31	Germ Fr Fr	598,315 41,699 712,617	Pressure hydrogenation of powdered coal at first in suspension and later in a thin layer on a support with a mechanical forward movement.
7194	8/14/31	Fr	740,664	Arrangement for low temperature carbonization and hydrogenation of coal. The crushed coal is put in rotating motions in a cylindrical vessel by a tangential stream of hydrogen between rigidly arranged baffle plates successively located along the longitudinal direction of the vessel.
7279	10/8/31	Germ	587,743	Measuring the ratio between pressures by a manometer connected to both pressures with an arrangement producing a directional force proportional to the pressure.
7676				See O.Z. 6152
8137	11/11/33	Fr Brit	779,597 430,069	A catchpot for the separation of gases and vapors from a liquid with the walls of the vessel in the gas or vapor space flushed with a liquid.
8272	11/28/33	Germ Fr Brit US	620,932 785,276 450,519 2,106,446	Removal of all constituents from the gas which do not form recoverable compounds with the purifying material, by treating with an alkaline medium in the first step, and the actual purification of

The I.G. Serial Number O.Z.	Date	Patent	
8272	11/28/33	Germ 620,932 Fr 785,276 Brit 450,519 US 2,106,446	the gases taking place in a second step.
8322	3/28/34	Fr 786,192	Insuring the pressure vessels against too high inside pressures by the use of a small plate welded on a perforated support to be used as a rupture plate.
8537	9/13/34	Fr 793,865	Horizontal converter with a rapidly rotating stirrer.
8561	9/29/34	Fr 793,865	Horizontal converter with several stirrers.
8572	10/6/34	Germ 704,592 Fr 795,400 Brit 458,583 US 2,097,605	Mixing of gas and liquid by passing through narrow openings or slits for better distribution of gases.
8594	10/20/34	Germ 679,387 Fr 796,972 Brit 450,969	Pressure hydrogenation in tower-shaped reaction vessels subdivided by vertical walls.
8652	12/1/34	Fr 809,340 Brit 459,232	Measuring the pressure difference inside the high pressure equipment by means of a hydraulically operated measuring device, and control of the pressure drop e.g. by the supply of glide oil.
8885	5/12/35	Germ 644,378 Fr 807,923 Brit 456,232 US 1,242,731	Two-cylinder piston machine for the continuous supply of gases and liquids by using a single complementary directing slide with a closing arrangement between the slide and two hydraulically operated main directing slides of the type of check valves, which interfere with the movement of one of the principal directing slides until the change over of the other piston pump to the delivery stroke.

The I.G. Serial Number O.Z.	Date	Patent		
~~8984~~	~~8/2/35~~	~~Fr~~ Brit	~~809,411~~ 469,735	~~A process for the recycling or~~ stirring of a hot mixture of liquid and solids, the vessel containing the liquid being connected with one or several valveless piston pumps by long pipe lines.
9115	11/22/35	Fr Brit	813,755 468,709	The hydrogenation gas is fed into the circuit by means of injectors operated by a liquid.
9235	2/12/36	Fr	817,287	Return of liquids into the high pressure space using injectors operated with the gas, preferably one participating in the reaction.
9249	2/19/36	Germ Fr	657,690 817,750	Safety arrangement for pressure release machines which automatically takes up the energy given off by the released medium by an additional load, when the normal load fails.
9259	2/26/36	Germ Fr	651,415 817,750	Safety of the pressure release machines insured by a branching line placed ahead of the pressure release machine and into which the compressed gas which does not enter the pressure release machine can be discharged.
9428	6/20/36	Germ Fr	653,689 823,211	A closing valve consisting of an upper and lower part of the casing with the valve seat set in between, ~~the seat composed of a hard elastic~~ material, with the tightening surfaces and the seats arranged at such an angle that the closing pressure is increased by the pressure of the valve contents and the valve cone.
9522	8/6/36	Germ Fr	713,101 825,157	The tightening of the high pressure vessels with a hard elastic ring arranged conically to the vessel wall and the cover and provided

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~~9522~~	~~8/6/36~~	~~Germ~~ ~~Fr~~	~~713,101~~ 825,157	with a supporting member to avoid excessive stresses.
9611	10/23/36	Germ	696,500	Pressure hydrogenation in tubes the length of which is more than 200 times the diameter, with the diameter or length of the rising tubes larger than the diameter or length of the descending tubes.
10073	6/28/37	Germ	695,995	Pressure hydrogenation in the liquid phase in inclined rising tubes the length of which is more than 50 times greater than the diameter.
10136	7/30/37	Germ	701,864	Pressure release of gases and liquids with a piston pressure release machine with two cylinder spaces divided by pistons, one of which is filled with an auxiliary liquid which is compressed into the second space during the pressure release, with the auxiliary liquid connected with the liquid in a surge vessel.
10427	12/22/37	Germ	716,121	Pressure hydrogenation in vertical tubes provided with insets.
10642 11099 12775	3/30/38	Germ Fr	746,937 850,495	Indication of the liquid level by means of an iron float which is moved during the rise or fall of the liq uid level inside the coils with primary or secondary winding and this changing the potential of the induced current.
10707	4/26/34	Fr Brit	789,251 457,447	The removal of liquids and gases from the high pressure space using shut-down arrangements with conical valve seats with a valve spindle rotating in the valve seat during the movement of the material.

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~~10729~~	~~6/30/37~~	Germ 704,937 Fr 839,505	A rapid closure of vessels by turning a special central piece with its own bearings arranged upon the closure and which is connected by means of directing rods with the center piece and is fastened to the wall of the vessel.
10724	12/13/37	Germ 743,613 Fr 846,870	Arrangement for measuring high pressures with a straight rod which is drilled excentrically to the rod axis, the deformation of that body under the effect of the inside pressure acting as the pressure indicator.
10749	7/4/33	Germ 647,666 Fr 775,292 Brit 433,496 US 2,052,693	Arrangement for pressure release of eroding materials from a pressure space through a replaceable valve head and a replaceable counter piece. By an axial movement of the valve head the annular space, which controls the flow, can be changed.
10755	6/10/37	Fr 838,808 Brit 514,926	Heat exchanger with channels for the materials between which the heat is enchanged, this channel being arranged in a metal block.
10756	9/7/39	Germ 706,950 Brit 514,857	Finned tubes for the preheater. Intermediate rings are welded to the tubes by electrical resistance welding and the fins attached to these rings.
10786	7/11/31	Germ 661,599 Brit 401,429 US 2,012,319	Arrangement for the let-down of products from the pressure space by pressure release in the cylinder of an engine, from which part of the pressure released product is pushed out by plungers, while the rest is recompressed to the pressure of the reaction space after closing the outlet valve.

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10788	6/24/27	Germ 485,768 Fr 656,402 Brit 292,614 US 2,029,606	Automatic closing of pressure vessels. The inside pressure acting upon the cover is used to expand by conical action a thin elastic packing ring resting on a support which is easily placed inside the vessel, and press it against the vessel wall.
11097	4/22/36	Germ 715,975	The conducting of thermocouples through the head piece of the thermocouple protecting tubes closed towards the outside and consisting of a hollow metal stopper which is closed with superimposed layers of packing of hard rubber, soft rubber, and gypsum, which act as an insulation for the wires of the thermocouple.
11099	10/26/38	Germ 715,046 Fr 878,871	See O.Z. 10642
11237	12/29/38	Germ 706,180	Stuffing boxes using a number of packing rings arranged one back of the other with a pressure drop between the individual rings, which is produced by means of a capillary tube connected at one end with the pressure space to be tightened; the capillary tube is provided with tapped places which are connected with the spaces between the packing rings and the other end of which leads to a space at a lower pressure or into the open.
11244	12/29/38	Fr 865,276	The closure of high pressure vessels with undivided nut on the outside or with undivided threaded stoppers.
11581	6/12/39	Germ 707,755	The removal of liquids under pressure. The gas separated from the cylinder is separated from the pressure released liquid immediately after pressure release or even during the pressure release.

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11636	7/4/39	Germ Fr	740,674 887,038	Hydrogenation in pipe lines in which short narrow sections of tubes are spaced, the length of which does not exceed 1/3 of the length of the tube and the cross section of which has been so selected that a velocity in them is over 1 second.
11690	7/31/39			Measuring the amount and velocity of a stream of gas by passing a volume of liquid equal to the volume of the gas to be measured through an orifice, and using the pressure drop therein as a measure for the velocity of the flow.
11716	8/9/39	Fr	887,039	Tightening of pressure vessels and pipe lines consisting of conical rings of about parallelogram shaped cross section located between the corresponding ring surface of the parts to be connected, or of a plain ring of rectangular cross section located between a ring surface inclined towards the axis on the same side.
12290	8/11/40	Germ	736,284	Liquid circuit in which the liquid is taken from a catchpot where the circulating liquid is freed from gas, and the solids are dissolved liquids in the catchpot are returned to the circuit.
12775	5/21/40	Fr	882,115	See O.Z. 10642
12802 14355	5/30/41	Fr	892,366	Level indicators for a liquid in high pressure vessels in which the empty space of the vessel is connected to one side of a measuring box with a diaphragm, the lowest point to the other side and the diaphragm is connected with a magnetic core movable in a tube around which two coils fed with an alternating current are arranged.

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~~13154~~	~~12/16/41~~			~~High pressure vessels with flanges~~ into which the bolts for fastening the cover are screwed in part to the flange and in part to the jacket.
13196	1/10/42			A device for the continuous regulation of the capacity of constant speed piston pumps without loss of energy by means of an auxiliary piston with guide rods being moved hydraulically between a fixed and an adjustable stop in an auxiliary cylinder connected with the piston pump cylinder by a by-pass line from the pump discharge line behind the outlet valve to the space behind the pistons in the auxiliary cylinder and a direct connection between the heads of the pumps and auxiliary cylinders, whereby the head of the auxiliary piston towards the pump cylinder forms a valve disk and the fixed stop, which forms the head of the auxiliary cylinder, forms the valve seat.
13336	3/26/42	Fr	892,762	Heat exchanger consisting of a bundle of tubes surrounded by an inside and outside jacket, with the liquid flowing through the space between the two jackets, and the inner jacket surrounding the tubular bundle as closely as possible and having an opening which is connected gas tight with an opening in the outer jacket.
13369	4/9/42	Fr	892,980	Tubular bundle heat exchanger consisting of flat tubes which are welded or soldered on the two ends in the free fields of a grate or else are welded or soldered to collars joined by welding or soldering.

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~~13585~~	~~8/4/42~~	~~Protection against excessive~~ temperatures in the high pressure lines by spirally winding them with a metal band with the formation of air passages.
13651	9/10/42	Regulating pressure release engines by having the pistons moved by liquid pressure acting on the piston rod.
14085	3/20/43	A reaction vessel consisting of a pressure resistant wall, insulating layer and a metallic ring on the level of the upper surface of the catalysts.
14207 14494 14988	5/26/43	Recirculation in a reaction vessel effected by introducing the hydrogenation feed and hydrogen from below in the one of the two vertical sections of the converter formed by a separating wall and interconnected above and below so that the hydrogenation feed is made to circulate in the two spaces, with most of the hydrogen and of the reaction products drawn off at the upper end. When several converters are used, cooling is provided between them.
14252	6/21/43	Heat exchanger for the pressure hydrogenation consisting of a central tube in which the liquid hydrogenation residues rise, a space above, the upper part of which becomes filled with gases and vapors, and tubes of smaller diameters arranged around the central tube through which the residue flows downward and is cooled by the feed which is being preheated.

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~~14355~~	~~8/13/43~~	~~See O.Z. 12802~~
14393	9/6/43	A reaction vessel consisting of a pressure resistant wall and an insulation layer. The lump catalyst introduced into the vessel is weighted down.
14422	10/5/43	Pressure hydrogenation in several stages with the first reaction vessel consisting of a heated tubular furnace.
14474	11/20/43	Apparatus for a temperature error-free measurement of pressure with the use of a doubly bent tube filled with a liquid, with the ratio of the lengths of the legs of the tubes to each other and to the volume of the liquid so chosen that the total thermal expansion occurs in one of the legs, and the lower liquid level in the other leg does not change with the temperature.
14494	12/6/43	See O.Z. 14207
14602	2/19/44	A cylindrical hydrogenation vessel with the bottom or/and the head shaped like circular troughs, causing the feed to be set in circular motion inside of the vessel.
14703	4/8/44	High pressure diaphragm pump characterized by supported diaphragm with the support distributed over the total surface of the diaphragm so moved by the stroke, that the support surface acquires a step-wise slope and the diaphragm cross section undergoes wrinkle-free bending.
14774	6/4/44	High pressure valve. A lift magnet is used in addition to tension springs or tension weight, with the

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~~14774~~	~~6/4/44~~			~~lift magnet set in operation~~ by a contact manometer when the blow off pressure is reached.
14935	8/28/44			Pressure hydrogenation in a horizontal converter with the feed and the hydrogen kept in circulation inside the converter with the aid of one of several separated walls or sliding surfaces.
14956	9/28/44			The introduction of the feed and hydrogen from below into a vertical converter with conical ends and drawing off the hydrogenation gases and the reaction products from the upper end of the converter.
14970	10/7/44			Vertical cylindrical converter in which the feed and the hydrogen rise helically in the inner part of the converter and descend recirculating in the outer part of the space.
14973	10/7/44			Circulation converter in which part of the hydrogen is introduced into the reaction space in a finely divided form, in particular with the aid of a foam plate.
14974				See O.Z. 14973
14988	10/20/44			See O.Z. 14207
a_2) Nickel Oven				
10392	12/13/37	Germ Fr	698,851 846,944	High pressure vessels consisting of spirally arranged metal bands, the edges of which are welded together.

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~~10554~~	~~2/18/38~~	~~Germ 755,738~~ Fr 849,986 Brit 525,275	~~High pressure vessels consisting~~ of central tubes upon which steel bands are spirally wound in one or several layers, with the steel bands on the one side provided with one or several grooves and on the other side with tongs corresponding exactly to the grooves.
10733	5/4/38	Fr 849,986 Brit 525,275	The flanges are provided with grooves and tongs which correspond exactly to the band winding and upon which the ends of the winding are screwed on.
10812	6/4/38	Germ 697,891 Fr 855,601 Brit 529,540 US 2,253,093	High pressure vessels the pressure carrying wall of which is provided with two or more layers of spirally ground winding metal bands with groove shaped indentations with the indentation on the outer part of the metal band corresponding to the indentation on the inner part of the superimposed metal band and the hollow spaces thus formed filled with a wire.
11009	8/31/38	Fr 849,986 Brit 525,275	The cover is held in place by means of studs screwed in top of the wickel jacket.
11753	9/2/39		Strengthening in particular flanges by spiral winding of steel bands provided on the one side with indentation, in particular with grooves, and on the other side with elevation (tongs, corresponding in form and shape to the grooves).
11908	12/14/39		The core tube upon which the steel bands with grooves in tongs are wound in several layers have steel wires wound in the last layer, preferably inside of the grooves and under pressure.

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~~12013~~	~~2/15/40~~		~~High pressure hollow bodies in~~ which the successive layers of the bands are displaced in arrangement by less than half the width of the band, with the number of layers with displacement by $\frac{1}{n}$ of the width of the band, at least equal n or suitably a whole multiple of n.
12014	2/15/40		The bands are made of other metals than steel, in particular of light metals or of plastics, while the core is made of steel or of the other above mentioned materials.
12445 13257	11/21/40		The production of pressure resistant hollow bodies by winding of bands with grooves and tongs upon the corresponding shaped core tube.
12710	4/13/41		The production of wickel bodies with the use of two rolls.
12768	5/16/41		Wickel ovens from unshaped bands using electrical spot welding.
12798	5/28/41		Wickel ovens with several rows for pressing at temperatures below 600°C on the last pressing place.
12848	6/25/41		Wickel process at 200 - 650°C, in particular at 550 - 650°C.
12855	7/3/41		An improvement of the process O.Z. 12445. The taking into consideration the expansion of the bands at middle temperature by the widening of certain definite grooves.
13046	10/18/41		The wickel processes with electric resistence heating, with first the bottom band length being heated then the upper.

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~~13047~~	~~10/18/41~~		~~The winding of the band in the~~ wickel processes at the annealing temperature, then quenching.
13085	11/6/41		The production of pressure resistant hollow bodies by spirally winding of metal bands using adjustable wickel feed tubes.
13257	2/16/42		See O.Z. 12445
13490	6/23/42		Profile bands for the production of pressure resisting hollow bodies with unsymmetrical grooves in such a way that the wound hollow bodies have the whole strength of the bands at places of the greatest strain.
13805	11/23/42		The production of hollow bodies by the wickel process with metal bands with the annealing proceeding separately from the wickel process.
14247	6/19/43		The production of a preliminary tension in the hollow bodies by pressing hot to above the yield point.
b) Heating			
3682 8653	7/28/26	Fr 638,325 Brit 275,248 US 1,857,814	Heating for pressure hydrogenation by a supply of heated gases which can be conveniently heated with electric heaters.
3805	10/28/26	Germ 529,049 Fr 641,344 Brit 279,825	The heating of the feed by electrical heating of the walls of the vessels. The use of the walls of the vessels as electrical resistances.
4085	3/26/27	Fr 650,974 Brit 287,855 US 1,920,886	Heating in part directly with hydrogen in part indirectly by heat exchange with the products withdrawn and/or entering.

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4871	6/14/28	Germ 686,757 Fr 676,270 Brit 322,489 US 1,890,439	A joint heating of the feed together with hydrogen at at least above 350°C to the reaction temperature (gas heated tubular preheaters).
5133	10/9/28	Fr 682,363 Brit 332,251 US 1,920,888	Heating of the material to be hydrogenated with heating media which are at least 100°C hotter than the reaction temperature but not above 800°C.
5830	8/26/29	Germ 542,992 Fr 698,886 Brit 348,189 US 1,955,014	Step-wise combustion of the fuel by the preheating of the hydrogenation feed in heating tubes.
5883	9/17/29	Germ 623,631 Fr 701,261 Brit 348,252 US 1,970,248	The addition of phenols, carbon monoxide etc to the feed to reach the reaction temperature during pressure hydrogenation.
5897	9/27/29	Germ 667,743 Fr 701,065 Brit 359,945 Brit 359,983	A gradual reduction of the energy supply and the heat absorption by the feed until the reaction temperature is reached. Gas heated ribbed tubes.
7142	7/10/31	Fr 737,103 Brit 385,433	Heating up of the feed in such a way which will result in the polymerization of the polymerizable part. Separation of the polymerized part during or after preheating.
7254	9/16/31	Fr 742,724 Brit 392,688	The removal of the excess heat by indirect contact of the products of the reaction with water under pressure.
7646	7/27/32	Germ 655,979 Fr 758,870 Brit 406,561	Preheating of the major parts of the feed together with the hydrogen in heat exchangers to the reaction temperature and the rest of the material with hydrogen in preheaters.

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7758	3/12/29	Germ	559,923	Heating the hydrogenation feed with hydrogenation gas heated to 1,000°C with the velocity of flow during mixing as nearly as possible to that of velocity of sound.
8118 9912	10/27/33	Germ Fr Brit	680,181 780,385 432,638	Preheating of the feed conveniently with hydrogen under pressure with the separation of part of the preheated material during or after the preheating and return to the preheater. With several reaction spaces the liquid is withdrawn into a vessel arranged between the different spaces.
8383	5/29/34	Fr Brit	790,552 434,307	Preheating of coal pasted with oil with a carbon content of over 75% using hydrogen under pressure with the time of residence of the coal paste within the temperature range of 260 - 410° shorter than 200 seconds.
8424	6/23/34	Germ Fr Brit	680,395 791,054 443,937	Regulation of the temperature by the addition of cold gas.
8501	8/11/34	Germ Fr Brit US	633,826 794,025 444,936 2,120,295	Regulation of the temperature by the addition of ammonia.
8612	11/3/34	Fr	797,156	Heating of pressure vessels. The temperature of the flue gas is below that at which the vessel looses the required strength under the existing pressure and in the absence of any heat removal.
8625	11/14/34	Germ Fr Brit	680,567 798,602 465,413	The addition of oxygen-containing hydrogen to the preheated feed.

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8626	11/14/34	Fr 798,602 Brit 465,413	Preheating of the feed with oxygen -containing hydrogen in the presence of catalysts which cause a combination of the oxygen with the hydrogen.
8650	12/1/34	Germ 660,219 Fr 798,912 Brit 452,512 US 2,120,296	Preheating the feed in heat exchangers with the hot reaction products, then adding additional heat.
8653		Germ 627,239	See O.Z. 3682
8660	12/8/34	Germ 683,202 Fr 798,750 Brit 456,371	Applying the heat liberated in the combination of hydrogen and oxygen to the indirect heating to the feed.
8808	3/21/35	Germ 740,478	Cooling the fixed bed catalysts in the reaction vessel continuously or periodically with flowing liquids.
9100	11/14/35	Fr 812,160 Brit 467,853	Regulation of temperature by a stream of colder gases in different parts of the reaction spaces, conveniently by means of well insulated tubes.
9148	12/13/35	Germ 703,101 Fr 814,082 Brit 469,618	Removing the excess heat in exothermal reactions by indirect heat exchange with wet steam.
9864	3/19/37	Germ 695,634	Preheating in ascending and descending tubes with a reduction of their cross sections in one or several places.
9892	3/27/37	Germ 696,316 Fr 830,493	An appreciably lower partial pressure of hydrogen is used during the preheating of the brown coals above 300 atm than in the reaction space.
9912	10/23/34	Germ 695,864	See O.Z. 8118

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9920	4/15/37	Germ	696,364	Regulation of the temperature in the reaction space by the addition of cooled catchpot residues.
9968	5/18/37	Fr	845,601	Avoiding and making harmless pressure variations in preheaters. The addition of glide oil, the use of interchangeable return bends of steel in the preheater.
10107	7/21/37	Germ	715,988	Preheating of coal paste in tubular preheaters up to the swelling temperature of the coal, then in tubes of larger diameters by the addition of preheated materials such as hydrogen or liquid hydrogenation products at temperatures above the swelling temperature.
10192	8/27/37	Germ	704,232	One part of the reaction products of the first stage is used for the preheating of the material treated in the second stage and the other part is used together with the reaction products of the second stage for preheating of the feed for the first stage.
10473 10901	1/17/38	Germ	707,851	The major part of the coal paste with a low coal content is preheated in a heat exchanger, the smaller part of the paste with the larger content in coal is either not at all or only slightly preheated in tubular preheaters to the reaction temperatures.
10674	7/31/37	Germ	725,603	Preheating of coal paste with hydrogen to nearly the reaction temperature, maintaining at that temperature for some time in the reaction space, then heating to the reaction temperature.

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10718	1/20/36	Germ Brit	663,555 474,332	A high pressure steam heat installation consisting of a heat absorbing and giving-up parts connected with a circulation pump and an arrangement of a collector connected to the circuit for the introduction of super heated steam.
11021	9/12/38	Fr	855,517	Removal of most of the heat by means of a cooling liquid and the rest of the heat by the introduction of a cooling medium such as cold gas.
12716	9/19/38			Tubular preheater with replaceable insets of ceramic material.
14169	5/12/43			Recovery of the heat contained in the hydrogenation residues by direct contact with hydrogen under pressure, which is to be then used in the reaction.
14538	1/3/44			Preheating only hydrogenation gas in the colder heat exchanger and then leading it together with hydrogenation feed through the subsequent heat exchangers.