OPEN-DIE FORGING EQUIPMENT

TÜV NORD CERT GmbH ISO 9001 / ISO 14001

TÜV NORD CERT GmbH OHSAS 18001

Integrated forging units

Forging presses

Forging manipulators

ZDAS

TS PLZEŇ

Hydraulic Forging Presses

Forging press CKW 1800, Nakamura Iron Works, Japan

Open-die forging is one of the most advanced production methods of semi-products for all branches of heavy engineering. By this technology, bar- and shaft-shaped forgings, blocks, discs, rings, balls, plates are forged as well as other complicated shapes according to customer's requirements. The forgings are forged by hydraulic presses incorporated in integrated forging units.

The open-die forging presses represent one of the basic groups of supplied forming machines in the production programme of ŽĎAS and TS Plzeň joint-stock companies. They are mainly used for piece and small-lot production. Technological experience and possibility to prove new designs at the company's own forge shop have created good conditions for supplies of integrated forging units of top technical level. Up to now, more than forty forging units of various tonnages have been built and supplied to various European and Asiatic countries.

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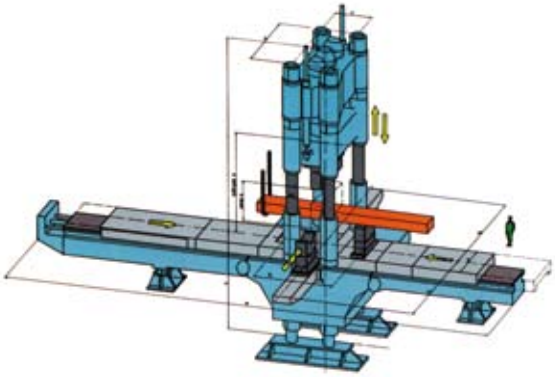
DNV

Classification of Hydraulic Forging Presses

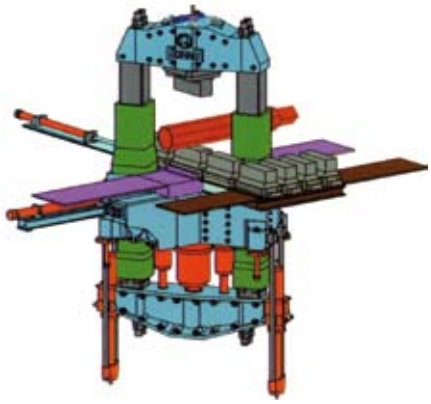
PUSH-DOWN PRESSES



FOUR-COLUMN PRESSES model CKV

TWO-COLUMN PRESSES model CKVX

PULL-DOWN PRESSES

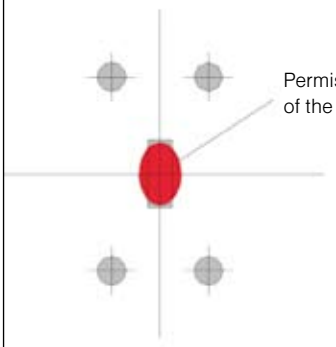
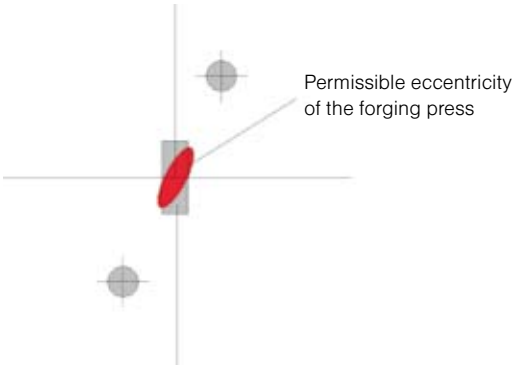
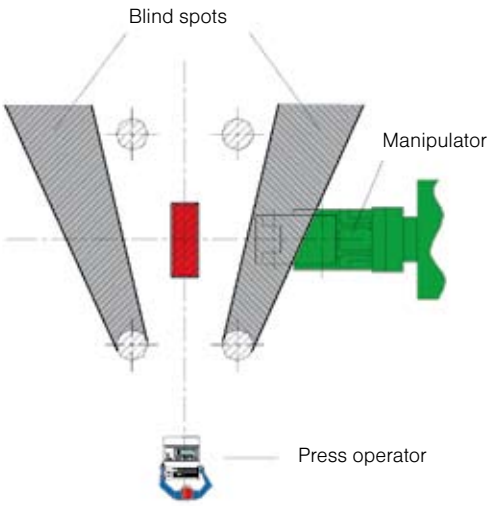
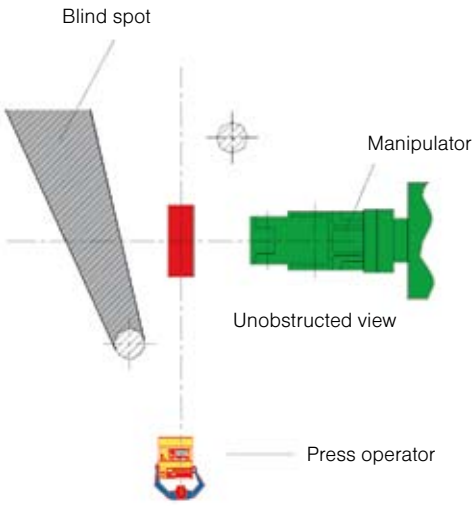
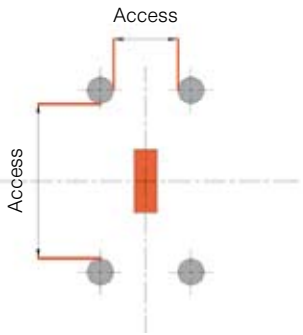
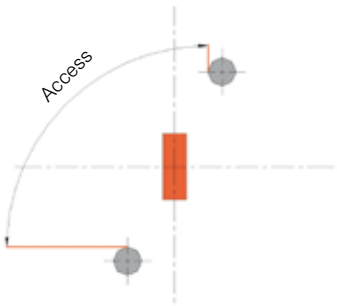
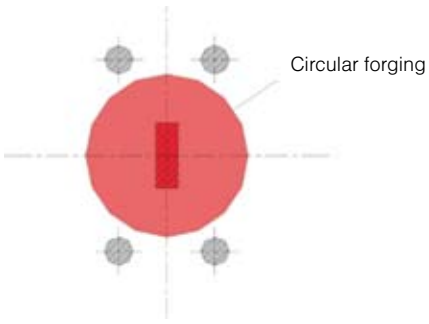
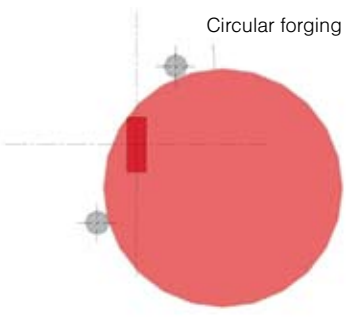


TWO-COLUMN PRESSES model CKW

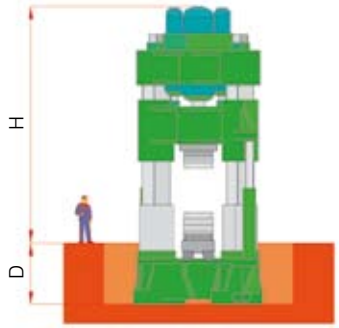
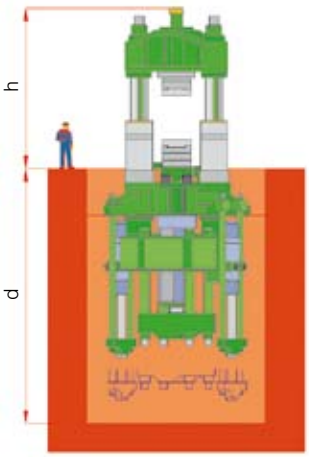
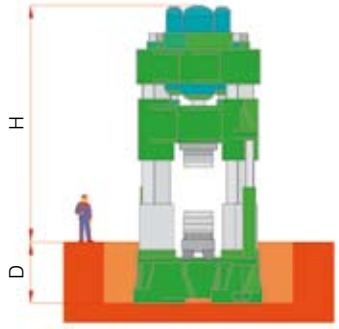
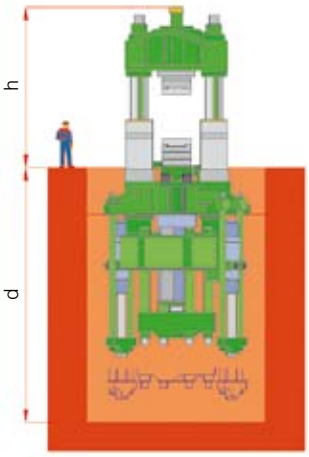
FOUR-COLUMN PRESSES model CKZW

Main Advantages and Disadvantages of Single Press Designs

ACCORDING TO NUMBER OF PRESS COLUMNS

	FOUR-COLUMN PRESS		TWO-COLUMN PRESS	
+	Double guide system, compared with the two-column press	**Press stability**	Half guide system, compared with the four-column press	−
+		**Range of permissible eccentricity**		−
−		**View of the forging and manipulator jaws**		+
−		**Handling access to the press**		+
−		**Dimensions of ring/ disk-shaped forgings**		+

ACCORDING TO PRESS TYPE

	PUSH-DOWN PRESS		PULL-DOWN PRESS	
–		**Workshop height requirement** **H >> h**		+
+		**Foundation depth** **D << d**		–
+	Press cylinders, all moving parts and related guide systems are located above the floor	**Accessibility of press parts for maintenance**	Press cylinders, all moving parts and related guide systems are located below the floor	–
–	In case of leak, working liquid gets into touch with the hot forging, which may result in fire	**Safety in case of working liquid leak from the oil drive**	In case of leakage of the working liquid, the fluid leaks directly into the retaining pits below the press	+

OPEN-DIE FORGING EQUIPMENT

List of Supplies since 1980

Integrated forging units

CKV 1000 + QKK 8	Czech Republic	ŽĎAS Žďár nad Sázavou	1981
CKW 630 + QKK 3	Czech Republic	Vítkovice Ostrava	1987
CKW 630 + QKK 3	Bulgaria	Radomir	1988
CKW 1600 + QKK 12	India	BFL Pune	1988
CKV 1000 + QKK 8	Ukraine	Uzhgorod	1989
CKW 1600 + QKK 12	Czech Republic	Vítkovice Ostrava	1989
CKV 630 + QKK 3	Czech Republic	TOS Hulín	1990
CKW 1600 + QKK 12	India	RFL Pune	1992
CKW 630 + QKK 3	Czech Republic	TŽ Třinec	1993
CKW 1000 + QKK 8	China	Tai Yuan	1994
CKW 1600 + 2x QKK 8	Iran	Machine Sazi Arak	1994
CKW 1800 + QKK 12	Germany	BGH Edelstahl Lippendorf	1998
CKW 6300 + QKK 80	Iran	EICO ESFARAYEN	1998
CKW 630 + QKK 3	England	Wyman-Gordon	1999
CKW 3300/4000 + + QKK 35 + QKK 15	England	Folkes Forgings	1999
CKW 1600 + QKK 12	Syria		1994
CKV 2650 + 2x QKK 20	India	MSF Ishapore	2001
CKW 4000 + QKK 35 + QHK 50	India	BFL Pune	2008
CKW 6300/7400	Turkey	MKE	2009-12

Forging presses

CKV 800	Czech Republic	Škoda Plzeň	1980
CKV 630	Czech Republic	ZVU Hradec Kralové	1982
CKV 1250	Czech Republic	Škoda Plzeň	1982
CKVJ 630	Czech Republic	ZVU Hradec Kralové	1983
CKV 800	Czech Republic	Škoda Plzeň	1984
CKV 1800	Czech Republic	ŽĎAS Žďár nad Sázavou	1987
CKV 2500	Czech Republic	Škoda Plzeň	1989
CKV 630	Czech Republic	ŽĎAS Žďár nad Sázavou	1990
CKVX 320	Czech Republic	ZVU Hradec Kralové	1992
CKW 1600	Czech Republic	Poldi Kladno	1980
CKW 630	Hungary	Dunai Wasmu	1981
CKW 1600	Rumania	28. August Bukcharest	1981
CKW 1000	Rumania	I.C.M.R. Resita	1981
CKW 1600	Japan	NAKAMURA Iron Works	1982
CKW 630	Czech Republic	Železárny Chomutov	1983
CKW 630	Rumania	I.C.M.R. Resita	1983
CKW 630	Czech Republic	1. Brněnská strojírna	1984
CKW 630	Czech Republic	Škoda Plzeň	1985
CKW 630	Slovakia	VSŽ Košice	1987
CKW 1000	Japan	NAKAMURA Iron Works	1994
CKV 800	Czech Republic	Škoda Plzeň	1999
CKVX 1250	Czech Republic	ŽĎAS Žďár nad Sázavou	2000
CKWZ 5600/6500	Czech Republic	Bonatrans Bohumín	2005
CKW 6300/7400	Iran	EICO, Esfarayen	2006
CKW 4000	Germany	BGH Siegen	2006
CKW 6000/8000	South Korea	MYSCO	2008-9
CKW 1800	Japan	NAKAMURA Iron Works	2009
CKV 4500/5000 + QHK 50	China	Pangang Group	2009-11
CKV 14000/17000	South Korea	Doosan	2009-12

Forging manipulators

QKK 12	Czech Republic	FORM Brno	1985
QKM 0.5	China	China Great Wall Comp.	1995
QKK 12	Czech Republic	ŽĎAS Žďár nad Sázavou	1998
QKK 80, QNM 1	Iran		1998
QKK 8	Italy	FOMAS	1998
QKK 5	Germany	BGH Edelstahl Lippendorf	1999
QKK 20 – 2x	India	MSF Ishapore	2001
QKK 1.5	Czech Republic	BONATRANS Bohumín	2004
QKK 35	Czech Republic	Škoda, kovárny, Plzeň	2004

QKK 3	Czech Republic	ŽĎAS Žďár nad Sázavou	2004
QKK 35 + QHK 35	China	Luoyang Mining	2006
QKK 35	Russia	EZTM	2009
QKK 100	China	CSOC / Wuhan Heavy Casting	2009
QKK 3	Japan	NAKAMURA Iron Works	2010
QKK 35	India	Bay-Forge	2010

Reconstructions

CKV 1600	Czech Republic	Železárny Chomutov	1983
CKV 840/1050	Czech Republic	Škoda Plzeň	1998
CKV 1800	Czech Republic	ŽĎAS Žďár nad Sázavou	1998
CKV 630	Czech Republic	Triangolo Hulín	1999
CKW 1000 + (QKK 5)	Germany	BGH Edelstahl Lippendorf	1999
CKW 1600	Japan	NAKAMURA Iron Works	1999
CKV 1000	Czech Republic	ŽĎAS Žďár nad Sázavou	2000
QKK 8	Czech Republic	ŽĎAS Žďár nad Sázavou	2000
CKV 1250	India	HFSI Thane Bombay	2000
CKV 2650	India	MSF Ishapore	2001
CKV 630	Czech Republic	ŽĎAS Žďár nad Sázavou	2004
CKN 800	Czech Republic	BONATRANS Bohumín	2004
CKW 1600	Czech Republic	POLDI HÜTTE Kladno	2004
Press 500T Pahnke	Japan	Nakamura Iron Works	2005
Press 2000T Pahnke	Germany	BGH Siegen	2005
Press 6000 T	Czech Republic	Vítkovice Ostrava	2006
CKV 2500	Czech Republic	Škoda Plzeň	2006
CKW 630	Czech Republic	TŽ Třinec	2006
CKV 1800/2250	Czech Republic	ŽĎAS Žďár nad Sázavou	2006
Accumulator station	Egypt	HELWAN FACTORY 99	2006
CKVJ 2650	Czech Republic	Pilsen Steel	2006
CKV 2650	India	HEC Ranchi	2007
CKV 2650	Slovakia	Metalurg IMMO Dubnice	2007
CKV 12000	Czech Republic	Vítkovice	2008
CKV 6000	Russia	VSMPO Verch Salda	2008
CKV 2500	Russia	VSMPO Verch Salda	2008
CKV 9000/12000	Czech Republic	Pilsen Steel	2008-9
Forging press 3000	Russia	EZTM	2009
CKV 11300	France	Areva	2009
Forging press 2000	Germany	BGH Edelstahl, Siegen	2010
IHI 800	Japan	NAKAMURA Iron Works	2010

CKW 3300/4000 + QKK 35 + QKK 15, Somers Forge Ltd., England

CKW Pull-down presses

Forging unit with the CKW 6300 press and QKK 80 manipulator – Iran

CKW 6000/8000 – Computer Model

CKW 1000 press – NIW, Japan

The CKW hydraulic forging presses are of a pull-down, two-column design. They are intended mainly for forge shops, where small press height above the floor is requested at the expense of deeper foundations. They are intended for all open-die forging operations on steel and non-ferrous metal forgings such as ingot upsetting, piercing, open-die forging of various blanks of circular and angular sections and mandrel forging of rings and hollow cylinders.

The press cylinders are mounted in an immovable middle cross girder and act on the lower cross beam of the movable frame down in such a way that the anvil clamped in the upper cross beam of the frame is pulled to the material.

The movable frame of the lower-tonnage presses, i. e. 6.3 and 10 MN, is cast monolithic and a single-cylinder design is used. The presses of higher tonnage, i. e. 16–70 MN, are provided with a sectional frame. Joints between of the columns and cross girders of the movable frame are pre-loaded by hydraulic nuts by means of anchors. The higher-tonnage presses are fitted with either one or three press cylinders that enable to select the forming force intensity (by activating one, two or three press cylinders).

The CKW hydraulic presses are standardly supplied with direct oil drive located below the forge shop floor.

The CKW hydraulic open-die forging presses feature a robust vertical structure with a long guide of the movable frame in the middle cross girder, and an oil closed-circuit lubrication system ensuring high service life of gibs and the whole equipment. All press motions are monitored by linear proximity sensors, data of which are transmitted to the control computer. By means of software, it is possible to control the whole integrated forging unit.

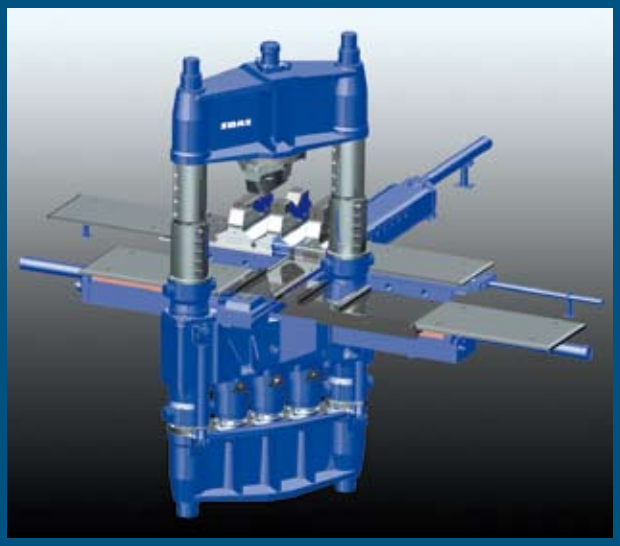
Rigid structure of the press and well-proven components in the hydraulic, electric and electronic circuit control ensure:

- safe operation of the press
- long service life and reliability
- admeasurement accuracy during forging ±1 mm
- auxiliary time reduction
- energy consumption reduction
- possibility of integration with the forging manipulator

Technical parameters

Nominal forming force	MN
Return force	MN
Stroke	mm
Maximum daylight	mm
Maximum eccentricity	mm
Column spacing	mm
Anvil plate stroke in longitudinal direction	mm
Max. height above the floor	mm
Max. depth below the floor	mm
Total length	mm
Total width	mm
Forming speed	mm/s
Number of planishing strokes	1/min.
Total installed input	kW

CKW 4000, Siegen, Germany



CKW 4000 – Computer Model

CKW 1600 + QKK 12 – RAJKUMAR FORGE, India

CKW 630 + QKK 3 – England

CKW 630	CKW 1000	CKW 1600	CKW 2500	CKW 3200	CKW 4000	CKW 6300	CKW 7000
6,3	10	16	25	32	40	65	70
1,1	1,9	2,8	4,8	5	8,9	13,7	13,7
800	1 000	1 250	1 600	1 800	1 800	2 500	2 800
1 800	2 250	2 800	3 600	4 000	4 000	6 100	6 400
140	180	200	250	280	400	500	500
2 250	2 800	3 500	4 500	5 000	3 400	4 700	4 700
±800	±1 000	±1 250	±1 600	±1 800	±1 700	±3 000	±3 000
3 065	3 920	5 340	6 830	7 450	8 700	10 400	13 500
3 830	4 670	6 340	8 100	8 150	11 000	13 500	16 500
8 620	10 700	12 700	15 800	19 800	21 500	23 200	24 000
10 070	11 650	13 500	16 100	20 500	21 000	21 750	22 300
100	100	100	95	75	70	63	63
100–120	90–110	90–110	80–100	85–90	70–80	60–70	60–65
650	900	1 360	2 150	2 720	3 200	4 600	5 000

The CKV conventional push-down four-column forging presses are applied in open-die forge shops and are intended for all open-die forging operations on steel and non-ferrous metal forgings such as ingot upsetting, piercing, open-die forging of various blanks of circular and angular sections and mandrel forging of rings and hollow cylinders. They are suitable for the shops, where a shallow foundation is requested that enables to install the press even in places with high underground water level.

The press cylinders push on the forging from above via a movable cross girder carrying the upper anvil. The sectional immovable frame consists of four forged columns pre-loaded in hubs of the upper and lower cross girders. The upper anvil along with the anvil holder is fastened on the movable cross girder guided in the frame by so-called three-point system. The middle press cylinder fixed in the movable cross girder is guided in the upper cross girder of the frame and the guide bushes mounted in hubs of the movable cross girder are guided by the frame columns. One or three press cylinders induce the pressing force, reverse motion is ensured by return cylinders fastened in the upper cross girder of the frame. The presses can forge with relatively high forging force eccentricity.

The hydraulic open-die forging presses feature a robust vertical structure ensuring high service life of the equipment.

All press motions are monitored by pulse generators or absolute sensors, data of which are transmitted to the control computer. By means of software, it is possible to control the whole integrated forging unit.

Rigid structure of the press and well-proven components in the hydraulic, electric and electronic circuit control ensure:
- safe operation of the press
- long service life and reliability
- admeasurement accuracy during forging ±1 mm
- auxiliary time reduction
- energy consumption reduction
- possibility of integration with the forging manipulator

The CKV presses standardly use the drive with working medium – 3–5 % water and mineral oil emulsion (central drive from the accumulator station is conveniently used for more presses installed in the forge shop). For the CKV presses, a direct pump drive can also be used running on mineral oil as working medium.

CKV 9000/12000 – Pilsen Steel, Pilsen, Czech Republic

CKVJ 2650 and QKK 35 – Pilsen Steel, Pilsen, Czech Republic

Technical parameters (with central accumulator drive)		CKV 630	CKV 1000
Nominal forming force	MN	6.3	10
Return force	MN	0.6	1.5
Stroke	mm	1 000	1 250
Maximum daylight	mm	2 000	2 500
Maximum eccentricity	mm	150	250
Distance between columns	mm	1 370	2 040
Max. height above the floor	mm	5 600	7 400
Max. depth below the floor	mm	1 440	1 700
Total length	mm	8 620	10 700
Total width	mm	10 070	11 650
Forming speed max.	mm/s	120	120
Number of planishing strokes	1/min.	100–120	95–110

* direct pump drive – oil ** 56 mm/s – 98 MN, 39 mm/s – 140 MN *** 2 columns

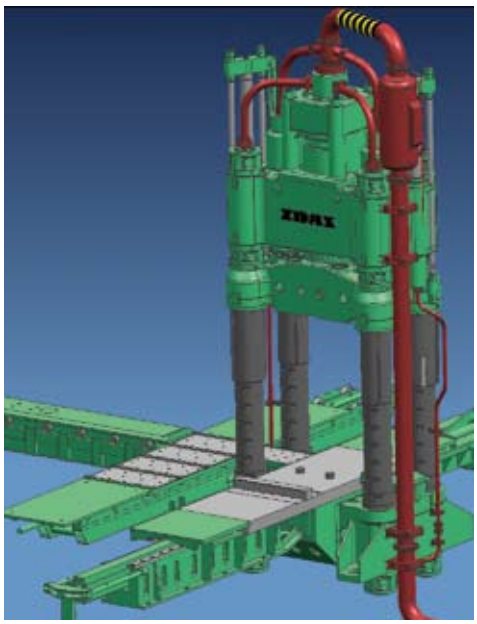
CKV

Push-down four column forging presses

CKV 9000/12000 – Pilsen Steel, Czech Republic

CKV 630 – CPF Praha, Czech Republic

CKV 2250 – Metallurgical plant ŽĎAS, Czech Republic



CKV 2250 – Computer Model

CKV 1600	CKV 2500	CKV 3200	CKV 4000	CKV 4000/ CKV 5000*	CKV 6300	CKV 8000	CKV 9000/ CKV 12000	CKV 12000	CKV 14000/ CKV 17000*
16	25	32	42	45	60	84	90	120	140
1.9	2.45	3.2	3.9	5.06	5.6	8.0	8.3	9.2	21.8
1 400	1 800	2 000	2 250	2 500	2 500	3 000	3 000	3 000	4 500
2 800	3 900	4 600	4 500	5 000	6 000	7 000	7 000	6 500	8 500
250	300	300	250	500	250	250	250	250	1 000
2 200	2 940	3 400	3 000	3 400/1 980**	4 000	4 300	6 000/1 600	4 700	7 500/2 600
8 000	9 800	11 200	12 500	10 900	14 700	17 800	17 795	18 900	23 000
1 900	2 600	2 800	4 500	3 500	5 500	6 500	6 480	8 000	6 500
12 700	15 800	19 800	21 500	23 800	23 200	24 000	43 100	42 000	51 500
13 500	16 100	20 500	21 000	14 750	21 750	22 300	21 500	28 000	33 600
120	120	120	70	80	63	63	63	60	56/39**
95–110	80–100	70–90	70–80	110	60–70	50–60	50–60	45–55	60

CKVX Push-down two-column forging presses

The CKVX hydraulic push-down forging presses of an up-to-date two-column design have all makings of economic production of high-quality forgings in more accurate tolerances. They are intended for all basic open-die forging operations.
The presses feature a sectional frame consisting of the lower and upper cross girders interconnected by two columns by means of pre-loaded anchors by hydraulic nuts. Located in the upper cross girder are press and return cylinders of a piston version. The press of a three-stage design is provided with side double-acting press cylinders of a piston type that also serve as return ones. The three-point guide of the movable cross girder locks the piston in the press cylinder and two pairs of flat guides on the press frame columns. The guide surfaces are arranged wedgewise to the press centre and are adjustable. The CKVX hydraulic open-die forging presses feature a robust vertical structure ensuring high service life. Their advantages are rigid frame and guide enabling higher-eccentricity forging, shallow foundation and improved view of the working space. The CKVX hydraulic presses can be driven both by the direct oil drive and by the accumulator drive with 3–5 % water and mineral oil emulsion. All types of drives use standard and well-proven components that make the operation failure-free and environmental friendly.
All press motions are monitored by pulse generators or absolute sensors, data of which are transmitted to the control computer. By means of software, it is possible to control the whole integrated forging unit.

Rigid structure of the press and well-proven components in the hydraulic, electric and electronic circuit control ensure:
– safe operation of the press
– long service life and reliability
– admeasurement accuracy during forging ±1 mm
– auxiliary time reduction
– energy consumption reduction
– possibility of integration with the forging manipulator

CKVX 1250 – ŽĎAS Forge Shop, Czech Republic

CKVX 320 – ZVÚ Hradec Králové, Czech Republic

CKVX 1250 – Computer Model

Forging unit with the press CKVX 1000 – Romania

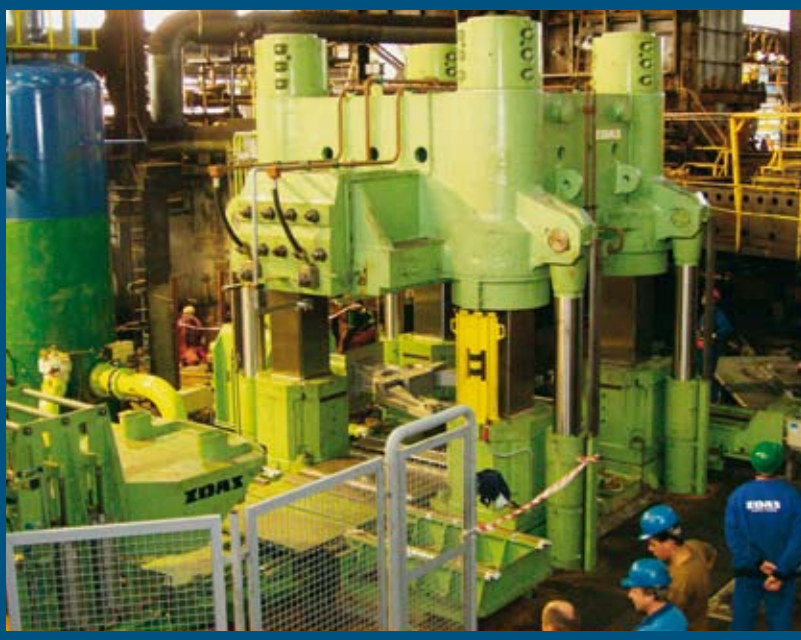
Technical parameters		CKVX 630	CKVX 1000	CKVX 1600	CKVX 2500	CKVX 3200	CKVX 4000	CKVX 5600	CKVX 7500
Nominal forming force	MN	6.3	10	16	25	32	42	56	75
Return force	MN	0.7	1	1.8	3	4	4.2	6	9
Stroke	mm	800	1 000	1 250	1 600	1 800	2 000	2 200	3 100
Maximum daylight	mm	1 800	2 250	2 800	3 600	3 600	4 000	4 500	6 600
Maximum eccentricity	mm	140	180	200	250	280	250	250	350
Distance between columns in longitudinal feed axis	mm	1 500	1 750	2 050	2 400	2 800	3 000	3 500	4 200
Distance between columns in adjustment axis	mm	980	1 050	1 120	1 200	1 300	1 300	1 350	2 200
Max. height above the floor	mm	5 200	6 000	7 100	8 250	9 700	11 500	13 000	15 500
Max. depth below the floor	mm	1 800	2 100	2 500	3 000	3 600	4 500	5 000	3 800
Total length	mm	8 620	10 700	12 700	15 800	19 800	21 500	23 200	27 000
Total width	mm	10 070	11 650	13 500	16 100	20 500	21 000	21 750	24 000
Forming speed	mm/s	100	100	100	95	75	70	63	80
Number of planishing strokes	1/min.	100–120	90–110	90–110	80–100	85–90	70–80	60–70	60–80
Total installed input	kW	650	900	1 360	2 150	2 720	3 200	4 500	5 800

CKZW

The press is of a vertical four-column pull-down design. Basic part of the press is the middle cross girder being mounted with its feet on four steel columns. The movable frame of the press consists of the lower and upper cross girders and four columns of square section. This frame is guided with its columns along the guides of the middle cross girder with the flat adjustable guide. Pressing force is induced by four pressing cylinders of plunger type built in the middle cross girder. Return motion of the frame is ensured by four return cylinders.

The hydraulic forging press is intended for hot-making railway wheels, i. e. it does the upsetting and forming operations by means of tools fastened on the upper and lower anvil plates. The press cylinders are mounted in the immovable middle cross girder and act on the lower cross beam of the movable frame down in such a way that the anvil fastened in the upper cross beam of the frame is pulled to the material. The press is provided with a sectional frame; joints between the columns and cross girders of the movable frame are preloaded using nuts. The CKZW hydraulic presses can be driven by both direct oil drive and accumulator drive with 3–5 % water – oil emulsion. All types of the drives use standard and well-proven components that make the operation failure-free and environmental friendly. It is possible to use the multiplier of a vertical design to attain increased pressing force.

It consists of lower and upper cylinders of different diameters. Inserted in the cylinder hollow is the piston with the piston rod. Located on the lower cylinder is the hydraulic control manifold.



CKZW 5600/6500 press – Bonatrans Bohumín, Czech Republic

CKWZ 5600/6500 – Bonatrans Bohumín, Czech Republic

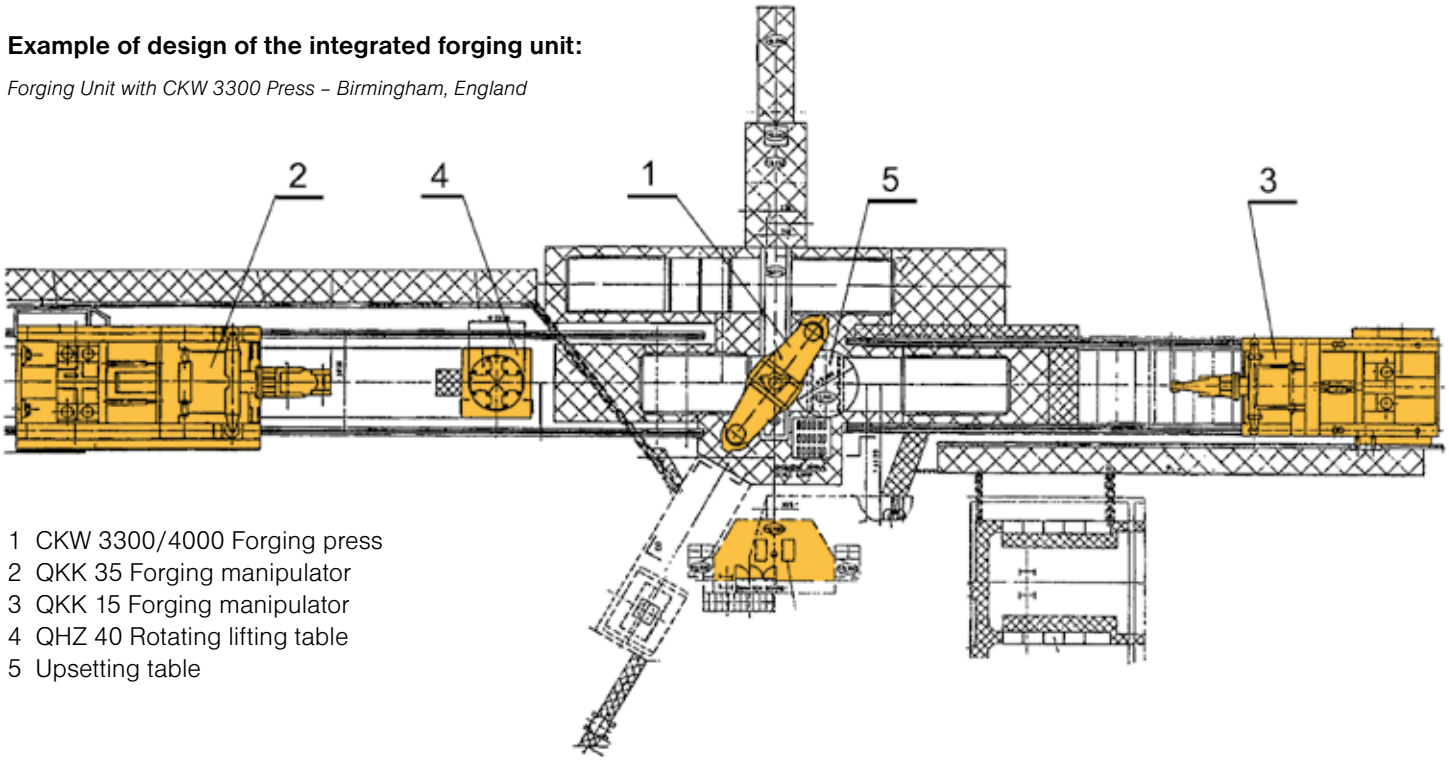
Technical parameters		CKZW 5600
Nominal forming force	MN	56
Return force	MN	6.15
Stroke	mm	1 100
Maximum daylight	mm	2 150
Distance between columns in longitudinal feed axis	mm	2 650
Distance between columns in adjustment axis	mm	2 750
Max. height above the floor	mm	5 250
Max. depth below the floor	mm	1 800
Total length	mm	12 000
Total width	mm	7 620
Forming speed	mm/s	76

Integrated Forging Units

The open-die forging unit consists of a forging press with hydraulic drive and of one or two forging manipulators. Electrical equipment of the unit along with a programmable logic controller ensures manual or automatic control including the integration “press – manipulator”. If requested by customer, the unit can be equipped with the ingot bogie, rotating lifting table, tool manipulator and with sets of tools in accordance with the technological application of the unit.
The forging unit is controlled by one operator from the central control console located in a sound-proof and air-conditioned operator’s cabin. The operator uses a push-button to select a suitable control mode for the unit with regard to immediate requirements of production technology. Physical demands on the operator have been significantly limited by the introduction of the automatic precise forging mode with an accuracy of measurement ±1 mm, by the installation of the technological process/fault diagnostics on the press, and by the automated tool change mechanism. This has resulted in quality improvement with very reduced technological allowances and high productivity of labour.
The control part comprises a programmable logic controller to control single machines within the forging unit, their link-ups, parameter setting and run monitoring including the display of important states of particular power units. The equipment enables user friendly operation with high automation level as well as monitoring of flow of the most important phases of the technological process.

Example of design of the integrated forging unit:

Forging Unit with CKW 3300 Press – Birmingham, England



1 CKW 3300/4000 Forging press
2 QKK 35 Forging manipulator
3 QKK 15 Forging manipulator
4 QHZ 40 Rotating lifting table
5 Upsetting table

Forging manipulator QKK 35 and ingot bogie QHK 50, BFL, Pune, India

Forging press CKW 4000, BGH Siegen, Germany

Forging manipulator QKK 100, CSOC, China

Forging manipulators are intended to handle a forging within the working space of the press. The current selection includes QKK forging manipulators with carrying capacities of 3, 5, 8, 12, 20 and 35 t. Manipulators of higher carrying capacities are designed and manufactured according to specific customer's requirements. The biggest manipulator which has been manufactured so far features a carrying capacity of 160 t. Transversally connected side plates form a rigid frame. This frame comprises a suspended box of the peel and a tongs swivelling/gripping mechanism. As all manipulator movements are performed hydraulically, the machine is equipped with a self-contained hydraulic drive and bladder accumulators. The machine is designed, hydraulically connected and electrically controlled in order to provide straight-line movements of a forging in the direction of all tree axes of reference, horizontal as well as vertical tilting and longitudinal axial rotation of a forging. The speed of travelling, rotating and vertical movements can be step-controlled.
Spring mounting of the tongs in vertical as well as longitudinal directions is provided by pneumatic-and-hydraulic springs. Functional movements of the manipulator can be controlled manually from the control console while the manipulator works as a teleoperator, or the automatic mode can be selected and the manipulator performs the preset steps and works in the selected mode according to pulses transmitted from the press. Automatic control is provided by using a programmable logic controller within the electrical control system.

Technical parameters			**QKK 1,5**	**QKK 3**	**QKK 5**	**QKK 8**	**QKK 12**	**QKK 20**	**QKK 35**	**QKK 50**
Carrying capacity		kN	15	30	50	80	120	200	350	500
Tilting moment		kNm	30	60	100	160	240	500	850	1 250
Max. tongs speed		min^{-1}	30	20	18	15	15	12	12	12
Max. travelling speed		$m.min^{-1}$	50	50	50	50	40	40	40	40
Main el. motor output		kW	23	33	39	95	95	140	190	230
Track gauge		mm	1 600	1 900	2 100	2 500	2 800	3 400	3 800	4 200
Diameter to be clamped	min.	mm	120	160	180	200	280	350	550	700
	max.	mm	350	500	650	750	950	1 250	1 600	1 650
Tongs height	min.	mm	600	650	700	960	950	1 200	1 150	1 600
	max.	mm	1 050	1 100	1 300	1 560	1 750	2 000	2 050	2 600
Overall dimensions	length	mm	4 200	5 880	6 500	8 170	9 100	10 180	12 150	13 640
	width	mm	2 300	2 730	2 950	3 450	3 800	4 650	5 400	5 800
	height	mm	1 720	1 930	2 150	2 690	2 850	3 370	3 800	4 470

QKK

QNK

Forging manipulators

QKK 80 manipulator with ingot bogie – Iran

Each manipulator is equipped with a number of sensors to monitor its main movements, i.e. travelling, slewing and vertical movements of the tongs. If the manipulator is used for the unit where one press works together with two manipulators, it is necessary, furthermore, to monitor transversal and longitudinal movements of the manipulator peel within the machine frame by means of sensors. Joint work of two manipulators makes high demands on the control system used to control the movements in order to provide a longitudinal tension stress inside the forging at any moment.

QKK 80	QKK 100	QKK 120	QKK 160
800	1 000	1 200	1 600
2 000	2 500	3 000	4 000
10	10	10	10
40	40	40	40
305	470	650	950
4 800	5 200	5 600	6 200
800	800	800	800
2 000	2 150	2 300	2 500
1 800	1 900	1 950	2 000
3 200	3 300	3 500	4 100
15 400	15 600	15 800	16 100
6 100	6 500	7 000	7 700
5 500	7 650	7 800	7 900

QNM tool manipulator

Tool rail manipulators of QNK type and wheel manipulators of QNM type are necessary to be used where the weight of tools does not allow them to be handled manually. These manipulators are designed to handle the forge tools (choppers, knives, piercing mandrels, etc.).

Technical parameters			QNK 1	QNK 2,5	QNK 5
Carrying capacity		kN	10	25	50
Tilting moment towards the front-wheel axis		kNm	45	115	250
Axis height	min.	mm	800	1 200	1 200
	max.	mm	4 000	5 000	5 000
Side movement		mm	±100	±200	±200
Tongs tilting	upwards	°	6	5	5
	downwards	°	6	5	5
Total installed capacity		kW	16	22	55

QHK Ingot Bogies

Rail-bound ingot bogies are designed to transport an ingot or a forging onwards before the forging unit. They move a heated ingot to the manipulator jaws, rotate a piece being forged and carry it away from the manipulator jaws.
A turntable used for loading a piece being transported or rotated is mounted via the radial-and-axial roller bearing onto a welded frame of the bogie provided with four or three axles, one or two of which are driven. Electromechanical drive of the turntable travelling and rotating mechanisms is provided by electric motors via spur gear boxes. Power supply for electric motors is ensured by means of cable drag chain.

Technical parameters		QHK 3	QHK 8	QHK 12	QHK 20	QHK 35	QHK 50	QHK 80	QHK 160
Carrying capacity	kN	30	80	120	200	350	500	800	1 600
Turntable speed	min^{-1}	5/2.5	5/2.5	3/1.5	0–5	0–2.5	0–2.5	0–2.5	0–2.5
Travelling speed	m/min	24/12	24/12	24/12	0–20	0–20	0–20	0–20	0–18
Height without turntable	mm	355	396	457	570	650	790	920	1 320
Height with turntable	mm	750	850	950	1 150	1 250	1 450	1 650	2 000
Travelling installed capacity	kW	0.75/0.55	4/3	7.5/4	11	13	15	18.5	30
Rotating installed capacity	kW	0.75/0.55	4/3	5.5/3	7.5	11	11	15	30
Wheel diameter	mm	320	360	400	520	560	580	620	900
Turntable size	mm	850x900	900x1 200	1 050x1 350	1 100x1 600	1 200x1 800	2 100x2 800	2 100x2 800	2 500x2 900

QHZ Rotating Lifting Tables

The rotating table allows a piece being forged, i.e. a semi-finished ingot or forged piece, to be rotated and taken by the manipulator by the other end in order to perform the finish forging of a piece.
The rotating table consists of a frame being fixed to the foundation. Moving within the frame is the cylinder which is secured by two springs to avoid its rotation. Lifting is provided hydraulically using working liquid and by means of hydraulic plunger-type cylinder. Turntable rotation is ensured by the hydraulic motor with a pinion and a gear rim carried on the radial-and-axial roller bearing of the turntable. The equipment is usually located within the manipulator rail-track area.

Technical parameters		QHZ 5	QHZ 10	QHZ 20	QHZ 25	QHZ 40
Loading capacity	kN	50	100	200	250	400
Stroke	mm	710	1 000	1 150	1 100	1 100
Maximum rotating speed	n/min	12.5	10	5	5	4

QWK Rotating Upsetting Tables

The rotating upsetting table serves to upset semi-finished products, flatten and plane the faces in case of disk and ring manufacture.This table is located on the forging plate of the press and the interconnection with the pump station of the press is provided by means of hose supplies with quick-acting couplings. The rotating table consists of a top forging plate, a middle plate and a body of the table with a spring-mounted bearing which allows the two top plates to rotate. The forging table is fixed to the forging plate of the press using fixing blocks. Rotation of the forging plate is provided by the hydraulic motor being fixed-mounted inside the table body.

Technical parameters		QWK 0,8	QWK 4	QWK 11	QWK 40
Loading capacity	kN	8	40	110	400
Forging plate diameter	mm	1 050	1 800	2 300	2 600
Table height	mm	680	850	1 100	1 150
Rotation speed	°/sec	90/45	60/30	30/15	18/9
Working overpressure	MPa	16	16	16	16

For forging of rings and cylinders, the piercing table located on the forging plate of the press is used to pierce the upset semi-product. The piercing table consists of a partly machined casting with a hook used for shifting from the tool magazine onto the press forging plate.

Automatic Tongs QMJV

Automatic tongs are a special equipment intended for handling the homogeneous metal ingots where eventual surface spalling and deformation at point of grasping the ingot by tongs is eliminable. They are designed for grasping a load of circular and square section.

Technical parameters								
Carrying capacity	kN	100	150	200	250	300	350	500

FORGING PRESSES HYDRAULIC DRIVES

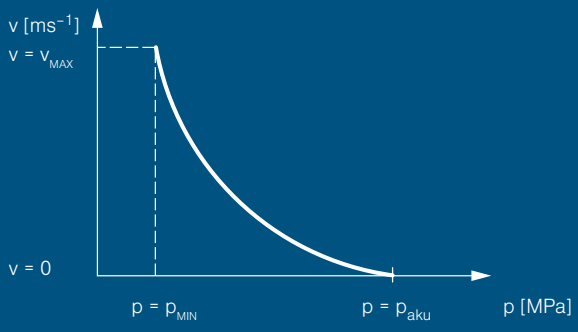
ZDAS

TS PLZEŇ

Accumulator station – HELWANT, Egypt

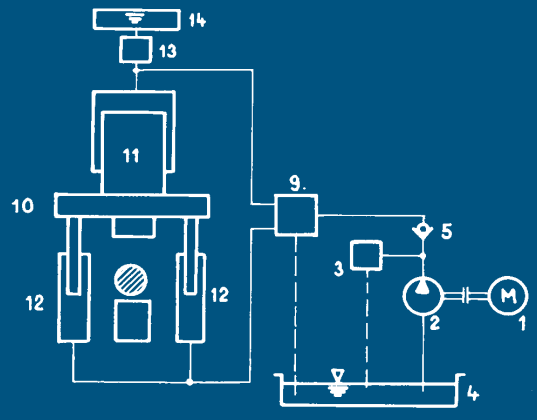
Computer model of the CKW 4000 press drive – Bharat Forge, India

The essential part of forging presses is the hydraulic drive which provides the requested forming force by means of pressure and determines the forming speed by the volume of liquid flow into the press cylinder. The magnitude of the forming force of the press is limited by the upset ingot, the size of a forged piece and by the kind of material used for a forged piece. The forming force has an essential influence on the fast running of the press, i.e. number of forming strokes per unit of time, on the number of interstage heats and on productivity of labour. The hydraulic drive has a direct influence on the economics of operation, i.e. electric power consumption, downtimes due to failures, maintenance requirements, and also on the environment. Forging presses of ŽĎAS brand can be additionally equipped, if requested by customer, with an optional type of the drives mentioned below.



Accumulator drive

The water accumulator drive is mostly used at present only for big systems which provide the drive for more presses from the central accumulator station which is advantageously dimensioned to an average consumption of driven presses, not to a maximum. If the distance of the accumulator station from the presses is too long, hydraulic shocks can occur in the interconnection piping (given by specific properties of water). These shocks must be eliminated by the additional installation of a shock absorber. For advanced water accumulator drives, the hydraulic control as well as power components are used the design of which is consistent with components intended for mineral oil. They differ mutually only in the used material and design modifications. Significant improvement has also been achieved in the service life and reliability of components as well as used sealing which are comparable to oil drives. This fact will certainly be a surprise for each user who has come into contact with this type of drive before and had quite different experience.



Direct oil drive

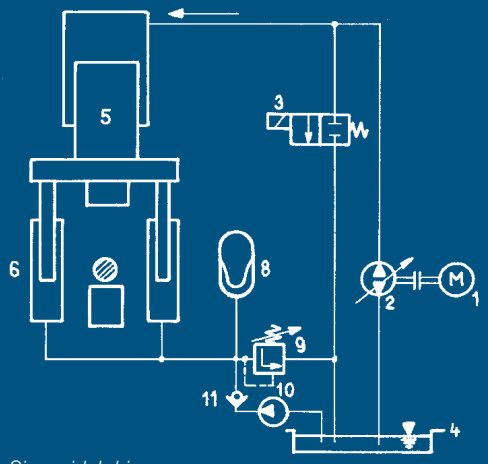
The basic principle of the **direct oil drive** is the application of a high-speed pump which delivers oil directly to the press cylinder, i.e. without the use of an interstage accumulator. The magnitude of forming force is direct proportional to the flow rate of the pump. As the pumps must be designed for a maximum forming speed, the direct drives require the installation of pumps of higher capacity than those for the accumulator drive which are designed for an average rate. The pressure at the outlet end of the pumps is little higher than the actual necessary pressure produced in the press cylinder in dependence on the forming resistance of material being forged. This results in a much higher efficiency of the drive. There has been a conviction for

FORGING PRESSES HYDRAULIC DRIVES

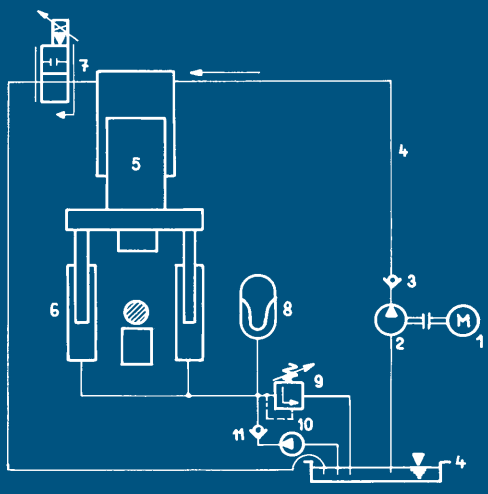
a long time, that for different reasons the direct oil drive can be used only for pull-down presses. Then this type of the drive came to be installed even at smaller push-down presses in USA and Japan, and today we can see it installed also at bigger presses.

The improved version of the direct oil drive is a sinusoidal drive. The system represented features the main pump and the auxiliary pump used only for battery charging and covering the accumulator losses. The change in the oil flow direction is carried out directly on the main pump. The control manifold with valves need not be used and moreover hydraulic shocks are reduced.

The **direct drive with a fast-acting forge valve** results from the idea not to change the liquid flow direction in the interconnection piping between the pump and press cylinder, but to use oil constant-delivery pumps. Return cylinders are permanently connected to the accumulator. The principle is as follows:
With a fully closed valve 7, the forming operation of the press takes place at a maximum speed given by the full flow from the pump. The pressure increase in the press cylinder is direct proportional to the forming resistance. At the moment of reversing the valve starts to continuously open so that “soft” decompression can be performed (pressure reduction in the press cylinder) and the press can be stopped downwards. Next opening the valve enables the flow from the pump and, due to the action of return cylinders upwards, also the flow of oil amount corresponding to that discharged from the press cylinder at a maximum return speed. Before reaching the top dead centre the valve is closed again and the process is repeated. This results in a continuous sinusoidal movement of the press with a very high number of strokes (as many as 210 strokes/min), and all of it with one valve used for control.



Sinusoidal drive



Drive with fast-acting forge valve

CKW 4000 – BGH Siegen, Germany

Mechanical Part Modernization

As far as the mechanical part of the press is concerned, the modernization consists in the renewal of the original geometrical shape and accuracy, the renewal of original power parameters and in the increase of speed parameters to the current level. The press is also equipped with the automated tool changing and clamping device, continuous movable-element position sensing device etc.

Hydraulic Part Modernization

Hydraulic distributions of the press drive are fully replaced by the advanced electrohydraulically controlled in-house manufactured distribution systems furnished with pilot elements delivered by the reputable world companies. The aim is to design distribution systems without any leakage and with elements enabling the automation of technological process control. The pressure oil or water emulsion is used as a pressure medium.

If the accumulator station is a pressure liquid source, either the general overhaul or modernization is carried out, or a new unit-type oil drive is provided.

As regards the forging manipulators, the general overhaul connected with modernization is carried out or the manipulators are replaced by new ones. Electrical equipment is generally replaced by new one fitted with a programmable logic controller and other components.

One of the examples in this field is the general overhaul and modernization of the forging unit with the press CKV 2650 and manipulator QKK 20 delivered by the company ŽĎAS to India in 1971. Modernization realized in the year 2001 included the following: essential repair of the mechanical part of the press, replacement of the accumulator drive of the “unit” by the new hydraulic oil one, delivery of two new forging rail-bound manipulators QKK 20 and modification of the rotating lifting table QHZ 20. The integrated forging unit is controlled by one operator from the central control panel located in the air-conditioned control cabin. The pump station is located at the forge shop floor level over the original hydraulic station. The main and auxiliary valve manifolds, prefill tank and the air distributor are installed in the modified space of the hydraulic station. This arrangement appears as optimum, low-cost and reasonable with respect to functionality of the forging unit. The original manipulator has been replaced by two new ones to fully meet all the conditions and requirements for the integration of the forging unit. Subjected to modifications was the manipulator rail-track as well. Electrical equipment comprising switchboards, control panels and the main control console in the operator cabin is quite new including cabling. The results of general overhauls and modernizations are the integrated forging units controlled by one operator from the operator’s position in the air-conditioned and soundproof cabin. Thanks to their technical parameters these forging units reach the current technical level.

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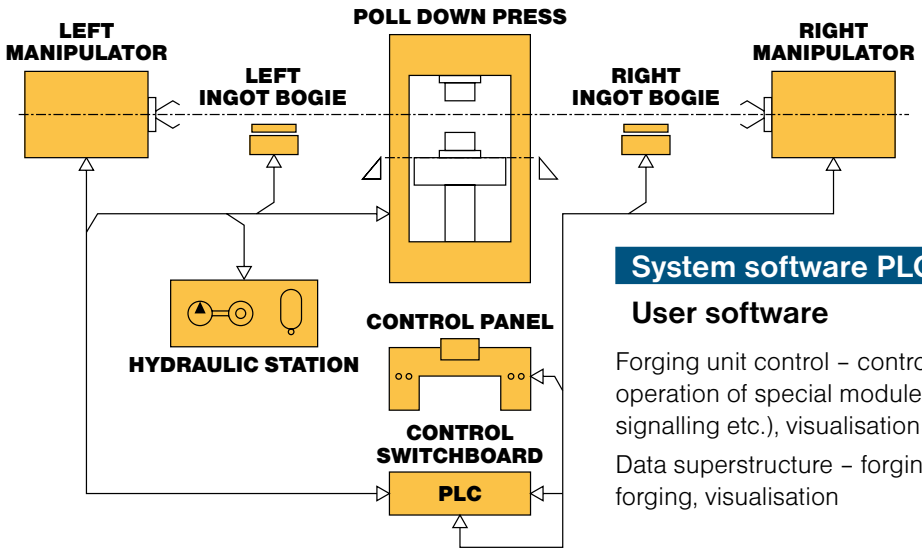
CONTROL OF THE INTEGRATED FORGING UNITS

An integral part of each forging unit is the control system which together with the hydraulic drive and sophisticated sensors in the mechanical section create capacity parameters of the each individual equipment within the unit or the complete unit. The control system design also creates a comfortable environment for the operating staff. The requirements on the control level result from the accepted company philosophy to control the forging unit with the single operator.

The electronics went through the storming development during the period since Žďas started to supply the forging units (approx. 30 years ago). From firmly wired control blocks consisting of the individual logic circuits through control automatic to the present shape when programmable logic systems of the prestigious manufacturer are used as required by the customer (Siemens, Mitsubishi, etc.).

The control system of the individual equipment within the forging unit and of the entire unit itself is the work of specialists and experts and it is based on long term experience gained during realisation of projects. Is also contains the knowledge and experience of the technological character achieved in operation of forging unit in the Žďas forging shop and from a number of system technological tests.



System software PLC

User software

Forging unit control – control software (technology, operation of special modules, diagnostics, fault signalling etc.), visualisation

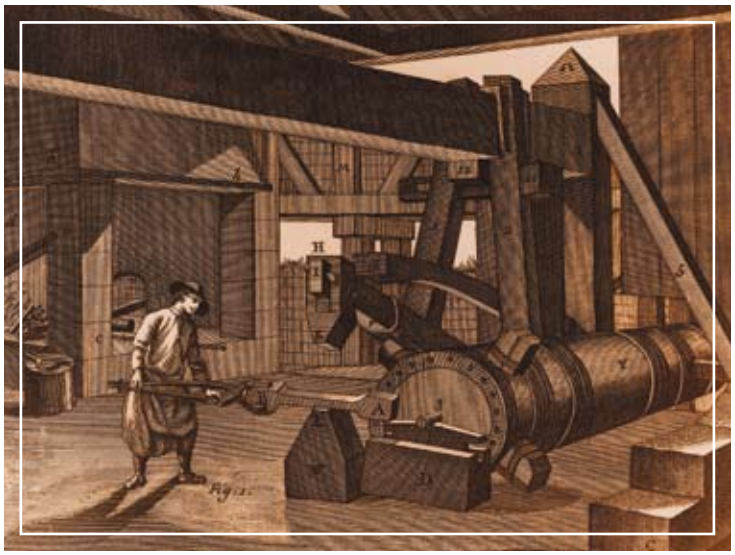
Data superstructure – forging from record, program forging, visualisation

The control system enables the operator to operate the forging unit in several modes – manual, semi-automatic and fully automatic. The mode is selected by the operator with respect to the momentary requirement of production technology. The automatic control modes of the entire forging unit include also accurate forging with the ±1 mm accuracy or forging from record. Our control systems enable diagnostics of the technological process and the possibility to correct the set up parameters during the automatic control mode. In case a failure arise on some equipment, the control system carries out its complete localisation and evaluation.

The present control systems delivered with the ŽĎAS open die forging equipment enable control of the forging press with two manipulators only with a single operator.

CKW 3300/4000 + QKK 35 + QKK 15, Somers Forge Ltd., England

NEW EQUIPMENT FOR TRADITIONAL TECHNOLOGIES



The joint stock companies ŽĎAS and TS Plzeň ensure any scope of supply of open die and die forging equipment. From the design, turnkey deliveries, through single-unit equipment up to integrated forging units. Service repairs, spare parts, modernizations and reconstructions of obsolete equipment represent a complex offer.

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