

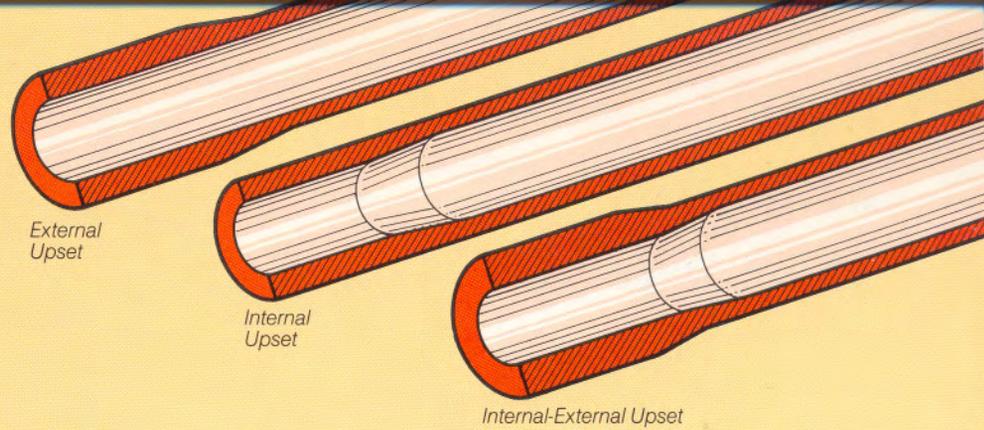
BULLETIN 93-A

# Ajax



## **Tube Upsetting Machines**

# An Introduction



Tube upsetters are used to hot forge the ends of tubes. This increases the wall thickness to provide the machining stock and strength necessary for joining the tubes together. The configuration of the tube end may be classified as EXTERNAL UPSET, INTERNAL UPSET, or INTERNAL-EXTERNAL UPSET as shown in the illustration.

The dimensions of the upset ends for oil country tubes are those specified by API, Hydril, or others. Depending upon the type of upset, in one operation the wall thickness may be increased, generally, by a maximum of 50% for EXTERNAL or INTERNAL-EXTERNAL UPSETS, and by a maximum of 100% for INTERNAL UPSETS. Based upon these limits, some of the API upsets can be forged in one operation but most of the API upsets require two operations, while most Hydril upsets require more than two forging operations. Ajax tube upsetters are designed to accommodate tooling for two operations which is the practical limit for a single heat. For those tube ends that require more than two forging operations, the first two

operations are completed for the production lot, then the tooling is changed in the tube upsetter and the tubes are again processed for the third and, if necessary, fourth operations.

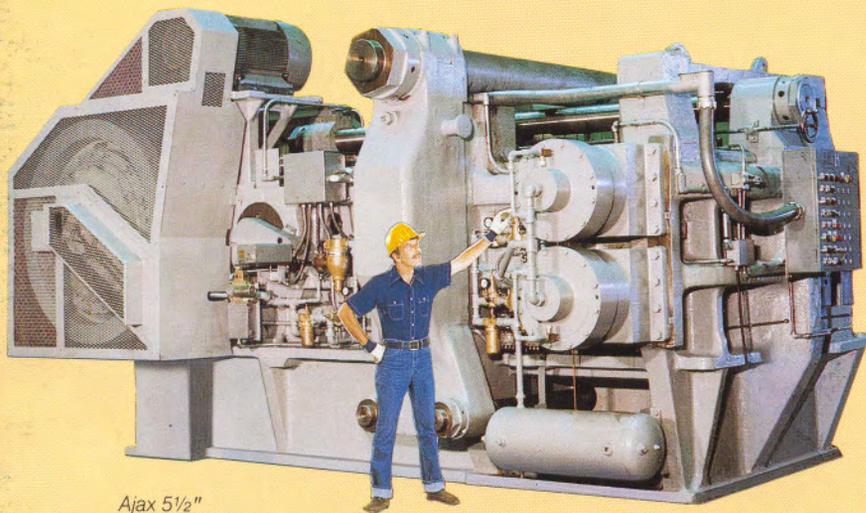
Forging of tubes generates tremendous forces across the dies. The forces are substantially more severe than those generally resulting from the forging of solid bar stock because greater die area is used to back up the forging operation. This forge area on tube upsets is normally about 3 to 10 times greater when compared to conventional forging machines. The forces required to prevent the dies from opening during the forging operations impose high loads to the toggles and the machine frame. Ajax tube upsetters are designed and constructed to withstand these forces and to provide reliable performance and minimal downtime.

In tube upsetting, it is necessary that the heading tool is long enough that the leading end is past the heated portion of the tube prior to the start of upsetting.

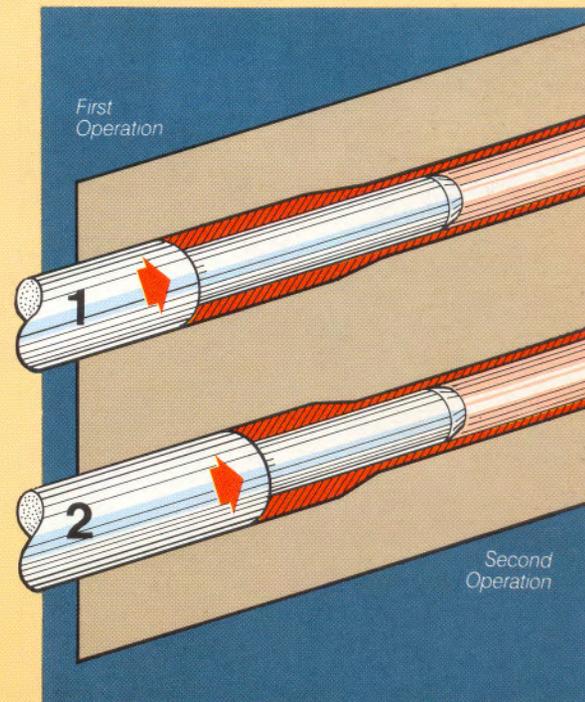
This results in a relatively long punch which must be retracted from the tube after upsetting. This requires not only a long headerslide stroke, but also, provisions to grip the tube in the dies during a large portion of the headerslide stroke. Compared to conventional forging machines, Ajax tube upsetters have substantially longer headerslide stroke, stock gather and hold-on.

The available die length on Ajax tube upsetters is considerably longer than that on a standard forging machine. This provides for the increased grip length required when forging tubes — 4 to 6 times the tube diameter as compared to 3 to 4 times the solid stock diameter for conventional forging machines. The result is a more reliable grip.

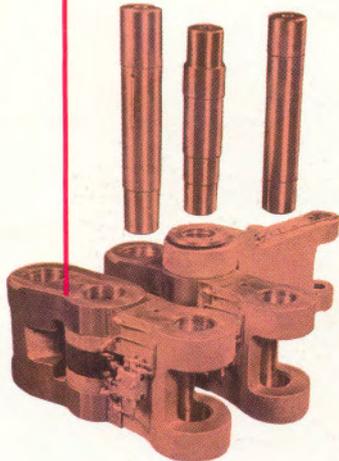
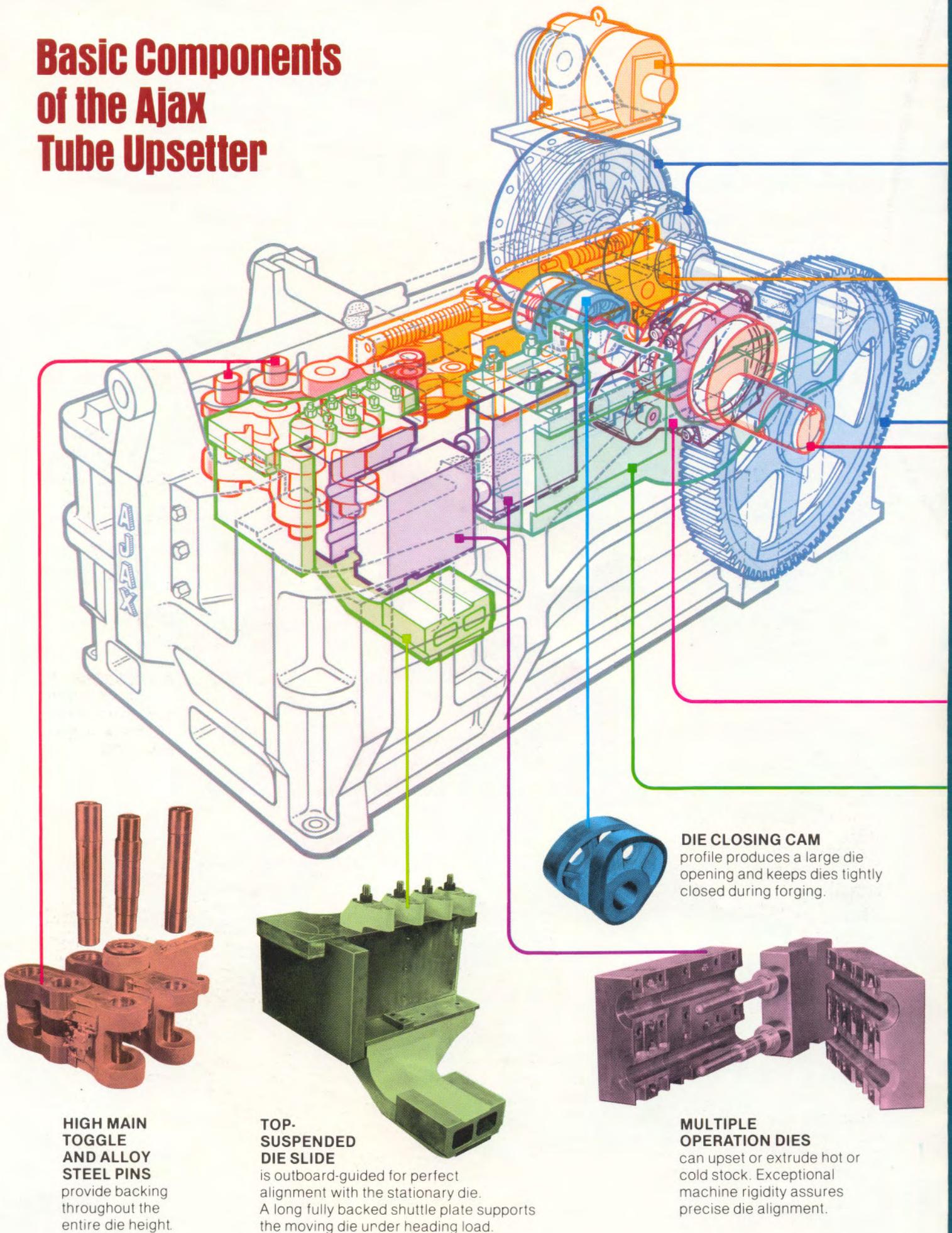
Ajax has helped industry produce the highest quality forgings for more than a century, and its machines are the result of years of problem solving and innovative engineering. We invite you to review the special features which have helped make Ajax the leader in modern forging machines.



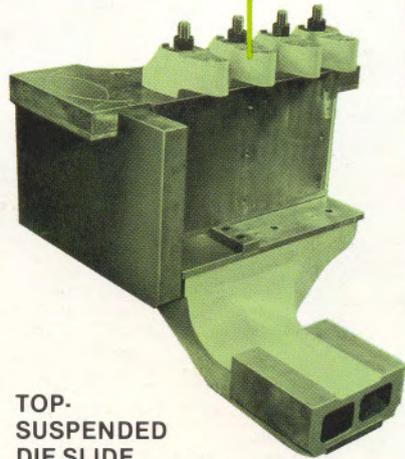
Ajax 5 1/2" Tube Upsetter



# Basic Components of the Ajax Tube Upsetter



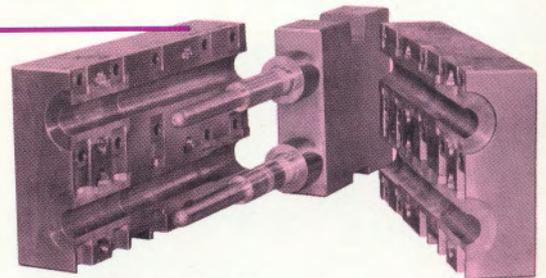
**HIGH MAIN TOGGLE AND ALLOY STEEL PINS** provide backing throughout the entire die height.



**TOP-SUSPENDED DIE SLIDE** is outboard-guided for perfect alignment with the stationary die. A long fully backed shuttle plate supports the moving die under heading load.



**DIE CLOSING CAM** profile produces a large die opening and keeps dies tightly closed during forging.



**MULTIPLE OPERATION DIES** can upset or extrude hot or cold stock. Exceptional machine rigidity assures precise die alignment.

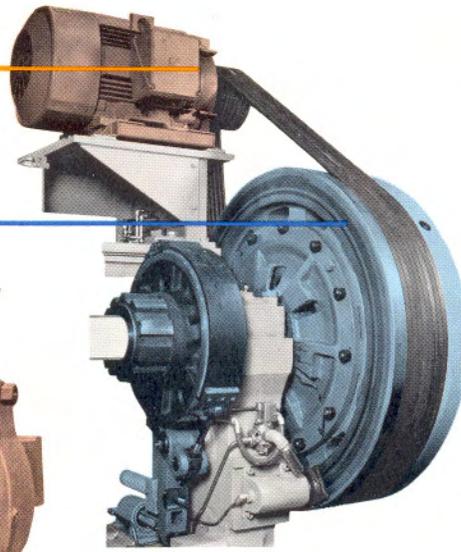
### POWERFUL DIE GRIP

keeps dies closed under load without auxiliary means. A self-contained safety can throw out anywhere in the closing stroke to protect the machine and tooling.



### V-BELT MOTOR DRIVE

is best for forging equipment because it adapts to a variety of motors and transmits full motor torque.



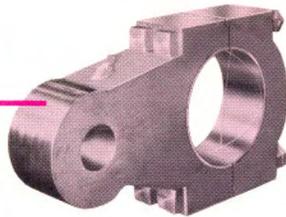
### AIR CLUTCH AND BAND BRAKE

offer fast, smooth starting and stopping. Conservative design assures long life and accuracy.



### CRANKSHAFT

Forged alloy steel crankshaft has large diameter eccentric pin, full diameter arms and long, large diameter journals. Crankshaft can be removed without disturbing the header slide.



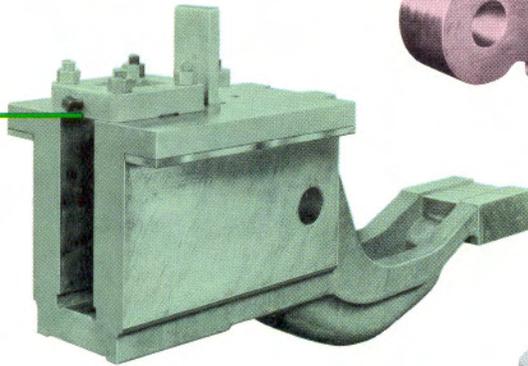
### ALLOY STEEL PITMAN

has an exclusive nose bearing that takes the forging stress and minimizes stress at the wrist pin.



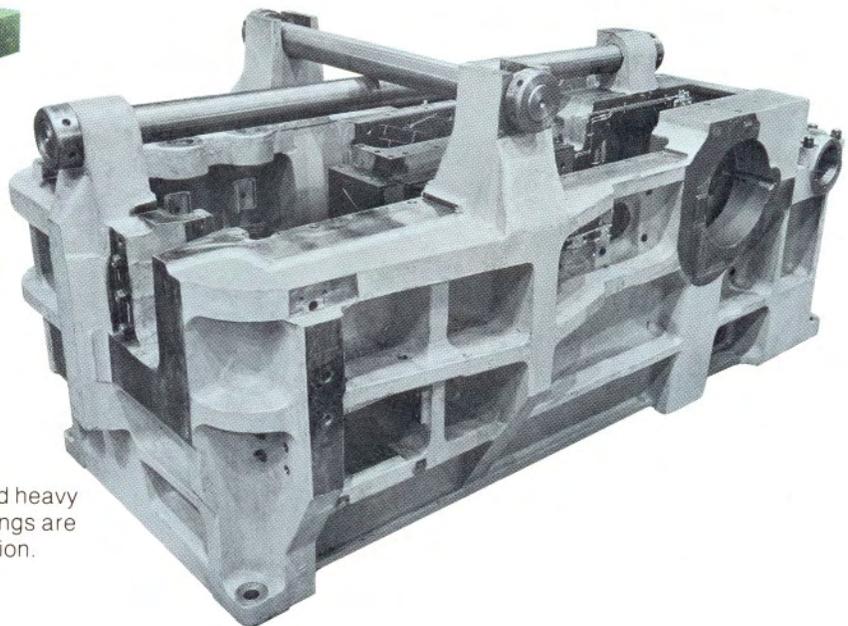
### MAIN AND PINION GEARS

are alloy steel and have machined teeth. Pinion shaft has anti-friction bearings and the main gear is double-keyed to the crankshaft.



### TOP-SUSPENDED HEADER SLIDE

is extension-guided to produce accurate forgings under any load conditions.



### RIGID STEEL BED

is a one-piece steel casting with thick wall and heavy ribbing. Continuous crankshaft bearing housings are integrally cast to minimize crankshaft deflection.

# Ajax

## Special Features

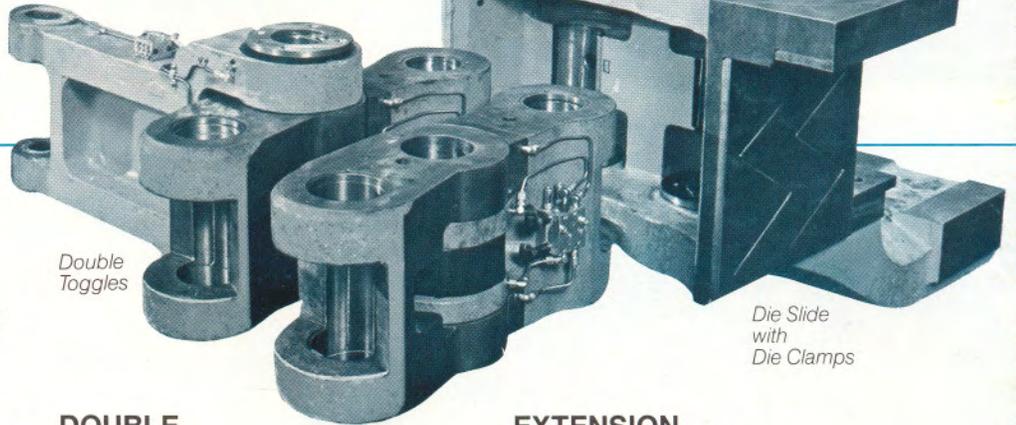


Die Grip

### POWERFUL DIE GRIP

The cam actuated, double toggle, die grip mechanism is ruggedly constructed and provides effective gripping without the use of backstops or auxiliary gripping means. The complimentary cam is mounted on the crankshaft. The cam profile is designed to impart smooth motion to the die slide during the opening and closing motions, and assures definite end positions of the die slide stroke. This simplifies tooling set-up, since the alignment between the dies and punches does not vary after installation.

In the event of misplaced stock or other obstructions, the safety mechanism, contained within the cam slide, will throw out anywhere in the closing stroke. This action trips a limit switch, which stops the machine cycle. Inching procedure is used to automatically reset the safety mechanism during the headerslide return stroke.



Double Toggles

Die Slide with Die Clamps

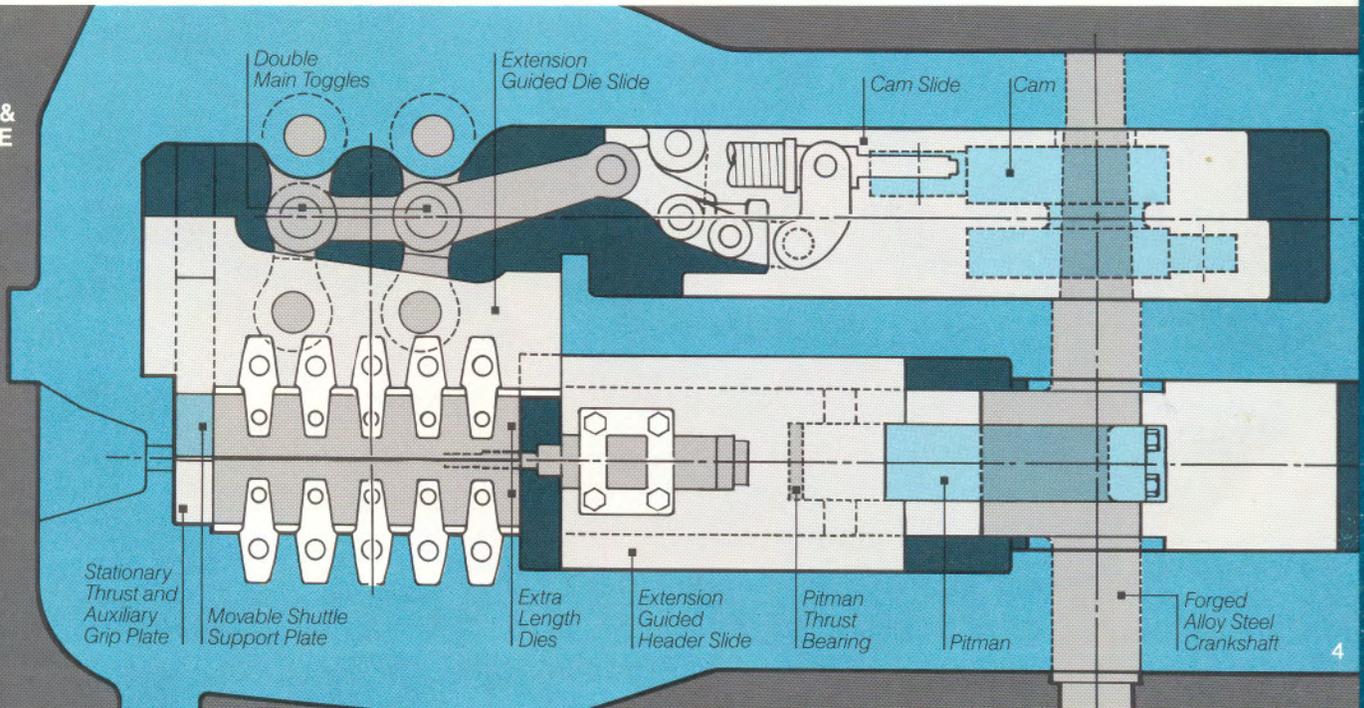
### DOUBLE TOGGLES

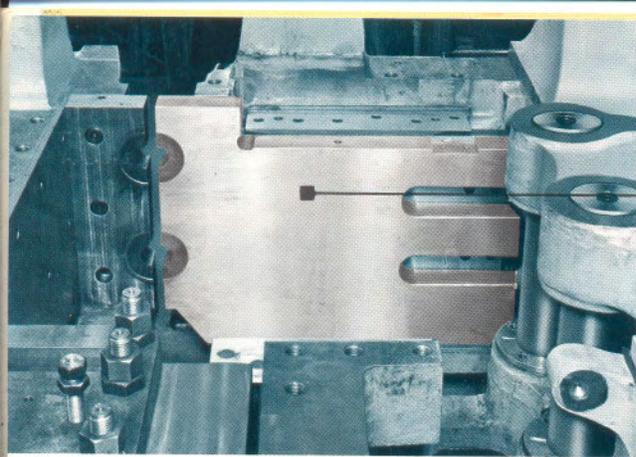
Double toggles are used to provide greater bearing area to distribute the forces created by the gripping and upsetting loads. Large diameter, alloy steel toggle pins provide the necessary backing through the entire die height and distribute the loads developed in closing the dies and holding them closed. This, coupled with the high strength of the frame results in reduced part flash, die wash, and extended tool life. All toggle bearings are lubricated by the automatic pressure system.

### EXTENSION GUIDED DIE SLIDE

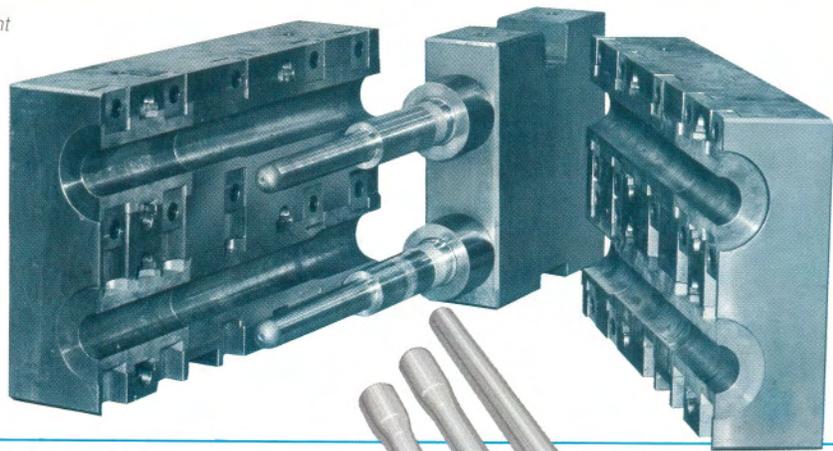
Two bearing lips faced with bronze liners operating on hardened steel shelf liners in the bed amply support the top suspended die slide. A rugged underarm joins the main slide body and the out-board extension guide. The extension guide, operating in an unstressed area on the right side of the bed, is supported on all four sides by bronze liners to keep the moving die in perfect alignment with the stationary die. This results in consistently precise, well matched forgings.

### PLAN VIEW of SLIDES & LINKAGE





*Independent Shuttle Support Plate in Open Position*



**MOVING DIE SUPPORT**

The shuttle support plate extends across the backing plate and moves with the die slide, on its own shelf liner, to back up the moving die under the heading load. This maintains the axial alignment of the moving and stationary dies.

As an option, the shuttle support plate can be arranged to operate independently from the die slide to also perform pre-clamping and tube stripping functions.

**EXTRA LENGTH DIES**

The available die length allows for extra long dies to provide ample gripping capacity for the entire diameter range of each machine. Single long dies simplify alignment since both the grip and working impression are in the same die. Also, single long dies within the machine provides maximum visibility for the operator.

**UNDERARM HEADERSLIDE AND PITMAN**

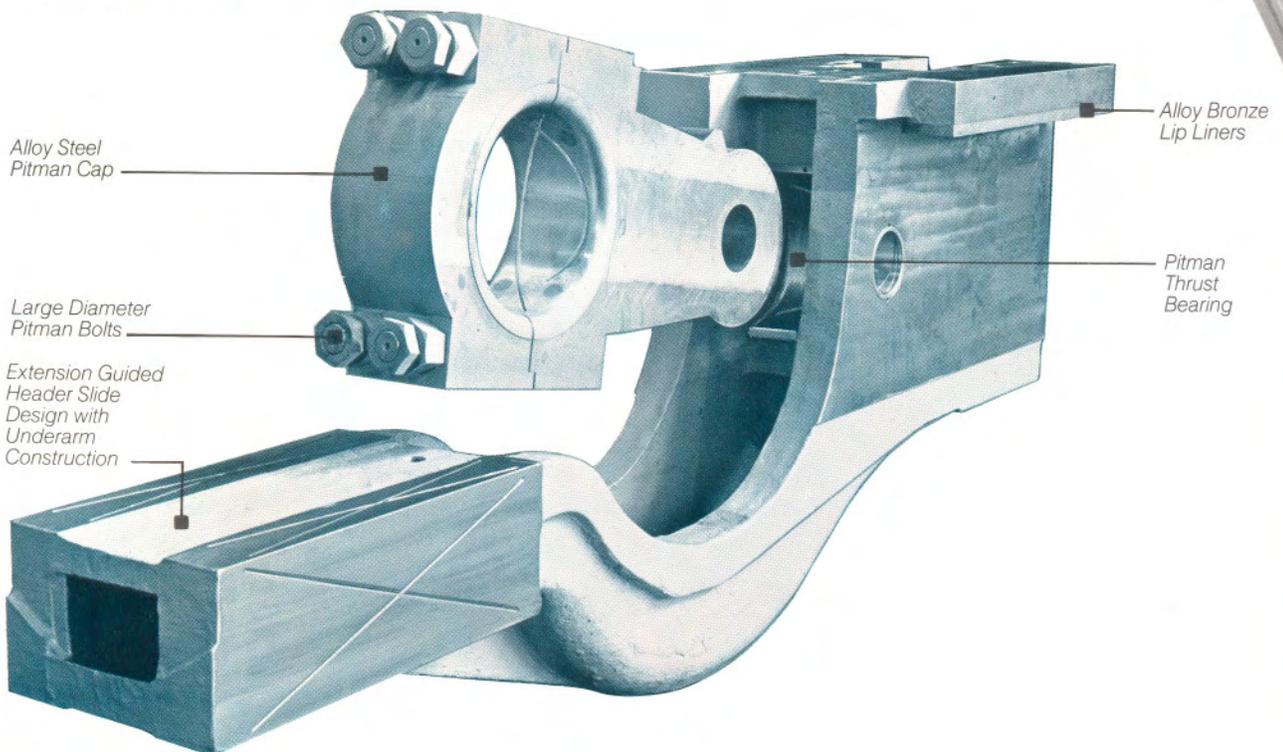
The main body of the slide carries the toolholder, the pitman thrust bearing, and the wrist pin connection. The slide is ruggedly constructed to prevent distortion due to heading forces. The main body is top suspended from two long, wide lips faced with bronze liners operating on hardened steel shelf liners in the bed. A strong underarm joins the main body with the extension guide. The extension guide, supported on all 4 sides improves forging accuracy regardless of load conditions. The extension guide liners can be removed for truing and shimming without disturbing the slide.

Underarm construction makes all major components visible and readily accessible.

The Ajax exclusive pitman design features a large thrust bearing on its nose which distributes the heading force and minimizes stress concentrations at the wrist pin bore. Bushings for the wrist pin are undercut so that the thrust bearing takes the full heading load. Large diameter pitman bolts are used to allow for the heavy pull-off loads encountered in tube upsetting.



*Progressive Steps in Forging Oil Field Drilling Pipe*



*Alloy Steel Pitman Cap*

*Large Diameter Pitman Bolts*

*Extension Guided Header Slide Design with Underarm Construction*

*Alloy Bronze Lip Liners*

*Pitman Thrust Bearing*

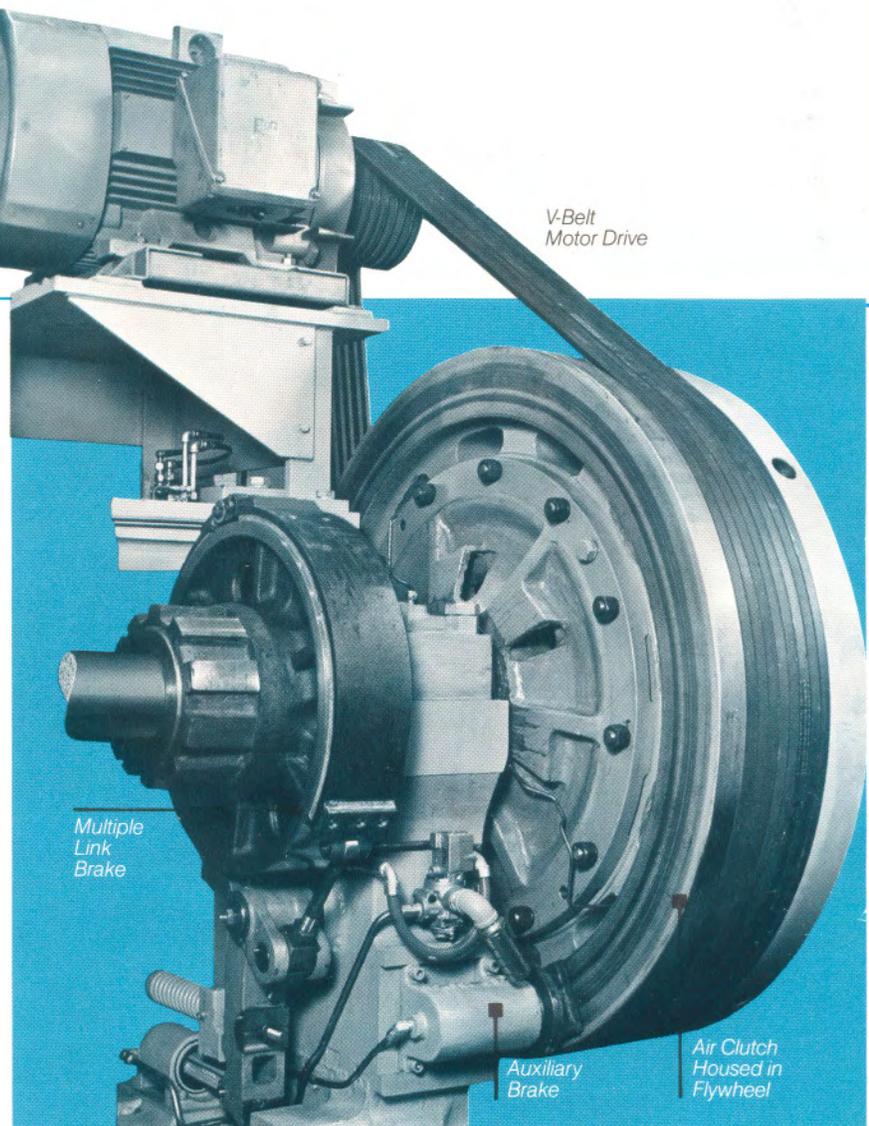
## Other Important Features

The direct-acting air clutch and the heavy duty link type band brake are smooth and responsive even at high production cycle rates. The multiple friction disc type clutch has integral ventilation and low unit pressure which maximizes friction lining life. The torque capacity of the clutch is controlled, and the clutch slips in the event of an overload to act as a safety device. The hinged multiple link type brake provides fast response. The clutch is spring released while the brake is spring set to provide for fail-safe operation in the event of loss of air pressure or electrical power. A separate auxiliary brake for stopping the flywheel is also provided.

Special analysis, heat-treated steel main and pinion gears have precision machined teeth. The main gear is double keyed to the crankshaft. The pinion shaft and the clutch plate are supported on anti-friction bearings. The capped housings for the pinion shaft bearings permit disassembly within the floor space of the machine.

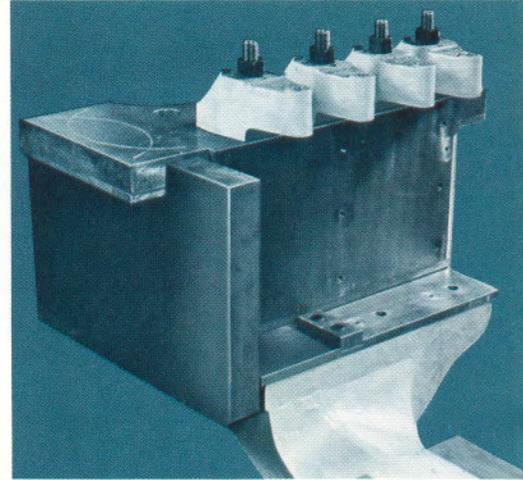
The bed frame is a one piece steel casting, completely strain relieved. Special care taken to assure proper metal distribution results in unusually low stress and high rigidity even in those frame sections which support the high forces developed across the dies. The frame strength across the dies is supplemented by a side clamp assembly (optional on the 3-1/2" 5-1/2" heavy duty and 7-5/8" sizes). The clamp is independent of the machine bed frame and consists of two massive steel castings connected by large diameter tie rods both top and bottom. During upsetting, the clamp provides crosswise support to minimize frame deflection, increasing die gripping capability by approximately 50%.

Tooling is arranged vertically for easy tool setting, and adequate die height is provided. The vertical die parting line also allows for easier die and tool cooling, and more efficient scale removal. Major components are designed for easy removal which reduces maintenance time.





# Standard Accessories



Slotted Tail Die Clamps

The slotted tail die clamps hold the stationary and moving dies securely in place. These clamps facilitate die changes, since they need not be lifted off the studs.

The straddle type toolholder clamp has provisions for keying the toolholder at the top. Combined with the bottom keying provided in the headerslide, this prevents the toolholder from shifting even under the heavy pull-off forces encountered in tube upsetting. Also, a wedge is provided in the headerslide, at the back of the toolholder, to provide full backing for the heading load.

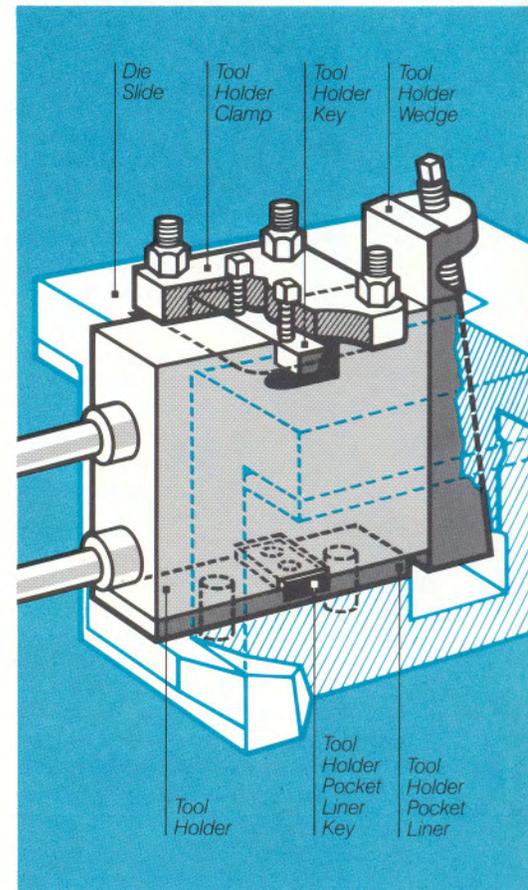
Ajax tube upsetters are powered by individual motor drives through multiple V-belts. The motor support bracket, V-belts, and motor sheave are standard equipment. The required motor with adjusting rails can be furnished by the customer, or by Ajax at extra charge.

Heavy steel shields for the gear and pinion, the headerslide and pitman assembly, and the cam slide and double

toggle assembly fit closely to prevent entry of foreign material such as scale. Along with the shield for the V-belt drive, the shields provide protection for shop personnel while permitting complete accessibility for inspection through conveniently located access panels.

An automatic, centralized, metered, pressure fed oil lubrication system supplies all principal bearings, except the anti-friction bearings of the clutch and pinion shaft which are pressure lubricated through individual hand fittings as are minor bearings requiring infrequent lubrication. The lubrication system is designed and installed for dependable, troublefree operation with convenient access for maintenance.

Pneumatic system accessories, including pressure regulators, pressure gauges, shut off and bleed valves, venturi air line lubricator, and air receiver tank are mounted on the frame permitting complete access for inspection.



## Specifications

* Machine Size	HEADER SLIDE		DIE SLIDE				DIE			MACHINE					
	Stroke	Load Rating/Tons	Stroke	Load Ratings/Tons		Stock Gather	Hold-On	Strokes Per Minute	Motor Horse-Power	Width	Length	Hgt.	Width	Length	Weight in Pounds
				During Closing	Fully Closed										
3½"	18"	400	5"	325	700	12½"	4⅝"	45	40	7"	34"	20"	9'0"	15'10"	115,000
5½" Standard	21"	550	6"	375	800	15"	6"	35	75	8"	45"	26"	11'0"	18'3"	195,000
5½" Heavy Duty	24"	700	7"	450	1000	15½"	7¾"	31	75	8"	45"	29"	12'0"	21'0"	265,000
7⅝"	28"	1100	9"	1000	2000	20"	8"	25	200	12"	52"	35"	15'0"	27'3"	518,000
12"	30"	1500	13"	1300	2500	19¼"	9"	21	250	14"	58"	48"	17'0"	33'9"	650,000
13½"	32"	2000	14"	1800	3000	20½"	9½"	19	250	15"	60"	52"	17'11"	35'6"	800,000

\* NOTE: Also Maximum Tube Diameter For Upsetting. NOTE: 5½" Std., 12" And 13½" Must Have Side Clamps.

## Optional Equipment

### CONTROL & INSTRUMENTATION

Electrical controls, including the starter for the upsetter drive motor, sequence and monitor the lubrication system and the two modes of machine operation (SINGLE CYCLE and INCH) by a series of relays.

With the control set for SINGLE CYCLE, the foot switch actuates control relays which sequentially release the spring set brake and then engage the spring released clutch. The cycle is controlled by a rotary cam limit switch, chain driven by the upsetter crankshaft, which sequentially disengages the clutch and then engages the brake to end the cycle with the upsetter at back center position. Circuitry requires that the operator release the foot switch prior to starting another cycle. Depending upon requirements, the foot switch can be replaced by a pair of RUN pushbuttons.

With the control at INCH, the motor is used to bring the flywheel to a speed suitable for inching. Two INCH pushbuttons actuate the control relays, causing the upsetter to cycle slowly until the INCH pushbuttons are released. Inching is accomplished from the stored energy of the flywheel — the motor is not powered.

Instrumentation to monitor the temperatures of critical bearings by means of thermocou-

ples utilizing meters and/or recorders can be supplied. Tachometers, load monitors, and other recording or diagnostic instrumentation can also be furnished.

The Ajax engineering staff is ready to custom design a control and instrumentation system to meet your specific needs and interface with the complete production line.

### PRECLAMPING MECHANISM

The shuttle support plate is operated independently from the die slide and is powered by a large diameter air cylinder. The shuttle support plate and the stationary die thrust block are arranged to accept matching grip-er dies. The shuttle support plate operates before the start of the header slide stroke so that it clamps the tube against the stationary die. This preserves the stock gauge position and aligns the tube with the punch, assuring that the punch enters the tube cleanly. After the forging is completed, the shuttle support plate maintains its grip on the tube until after the die slide starts to open, allowing the punch to retract cleanly and stripping the tube from the moving die.

### TUBE EJECTORS

Air cylinder operated ejector pins, one for each tube position, located at the stationary die thrust block, act directly on the tube to push it out from the stationary die. Ample

stroke and adjustment of ejector pin length provide necessary ejection over the full range of tube diameters.

### RETRACTABLE STOCK GAUGE

Located to the left side of the headerslide, the stock gauge can travel into the space allowed by the open moving die. This permits the entering tube to be stopped within the die so that the punch is guided in the die before upsetting begins. Prior to the start of the headerslide stroke, the stock gauge is automatically retracted to clear the moving die. The gauging position is fully adjustable over a wide range by means of a handwheel at the operator's position.

### RIGID BED SIDE CLAMP

A side clamp assembly can be furnished with the 3 1/2", 5 1/2" heavy duty, or the 7 5/8" tube upsetters. The clamp is independent of the bed frame and provides substantial crosswise support to minimize bed frame deflections during upsetting. This greatly reduces the formation of fins to the extent that multiple passes on difficult tube upsets can be taken in the same heat.

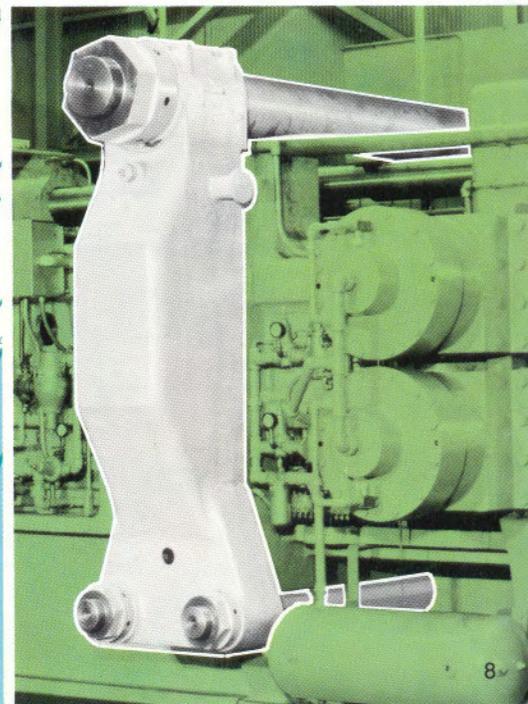
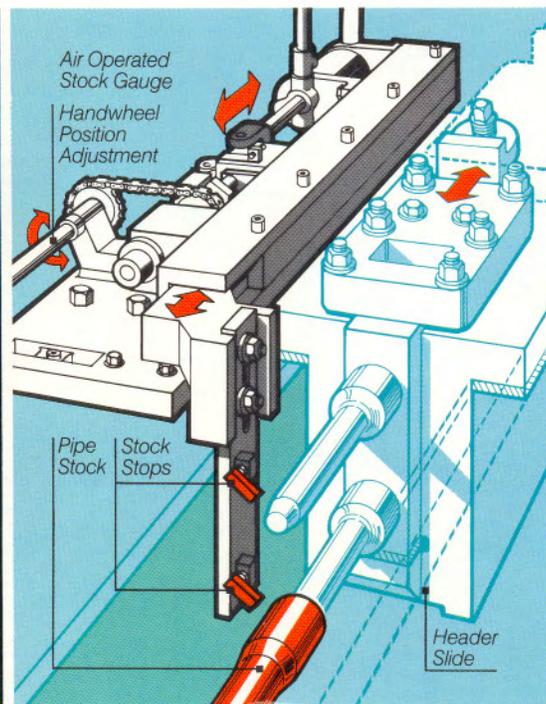
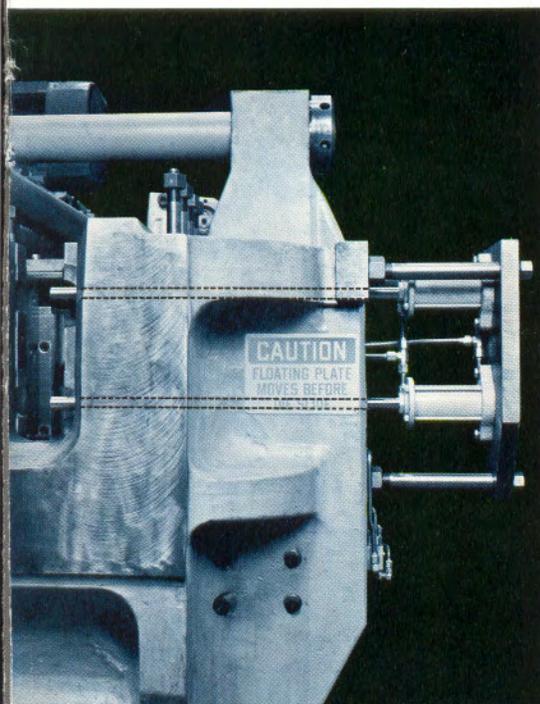
### DIE AND TOOL COOLING & LUBRICATION

Systems for die and tool cooling, and for automatic die and tool lubrication can be provided.

Tube Ejectors

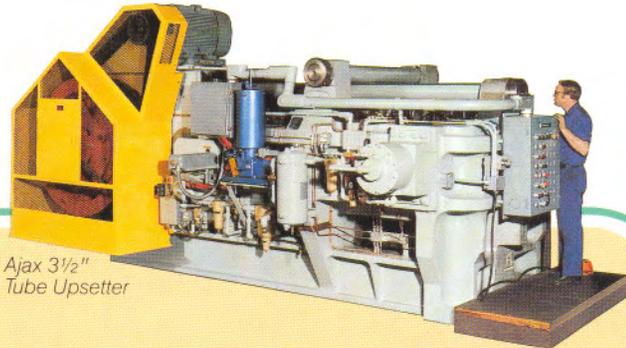
Stock Gauge

Side Clamp Assembly



## DIE AND DESIGN CAPABILITY

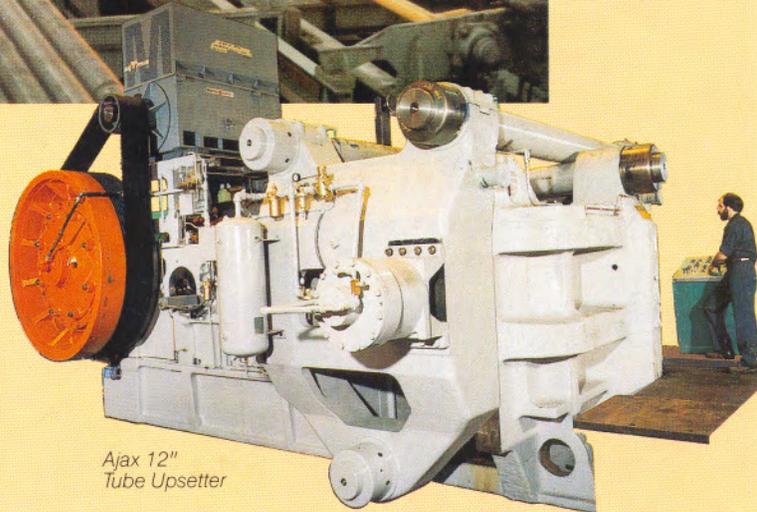
With over 100 years of experience in designing and building forging equipment, Ajax has the expertise to design, build and develop dies and tools necessary for the efficient production of quality forgings.



*Ajax 3 1/2"  
Tube Upsetter*



*Fully automated  
tube upsetter  
installation for  
tubes 4 inches  
through 10 3/4  
inches in diameter.*



*Ajax 12"  
Tube Upsetter*

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