Machine Tools Souvenir

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Machine Tools Souveni

(A QUARTERLY TECHNICAL JOURNAL DEVOTED TO MACHINE TOOL INDUSTRY)

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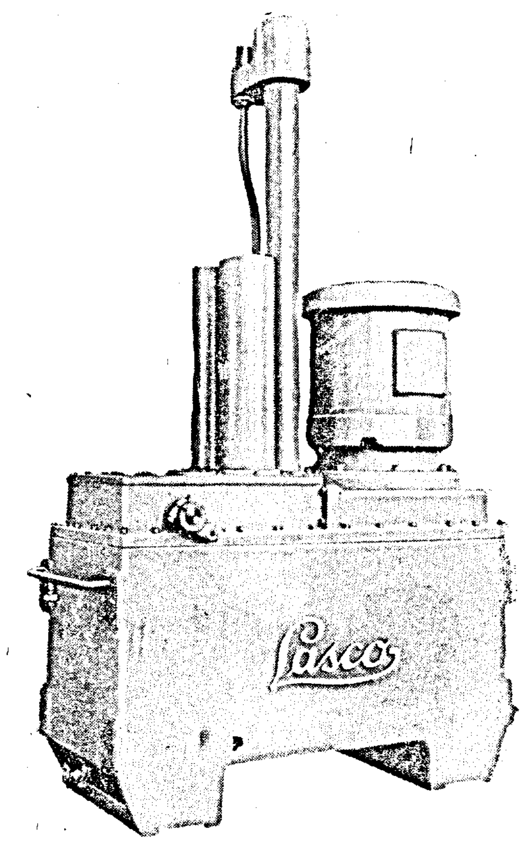

ELECTRO-HYDRAULIC DROP HAMMER HEAD

(See Page 13—16)

Our Editorial Board Hony. Members

MACHINE TOOLS SOUVENIR

(A QUARTERLY TECHNICAL JOURNAL DEVOTED TO MACHINE TOOL INDUSTRY)

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CONTENTS

Reservicing of Wimet Tungsten Carbide Tools

THE NATURE OF CEMENTED CARBIDE

IN order to understand the special technique required for reservicing tungsten carbide tools an understanding of the nature of cemented carbide is necessary. It is produced by a powder metallurgical process and consists essentially of minute particled of tungsten carbide cemented together by a metal of lower melting point, usually cobalt. Tungsten and carbon powders are mixed and processed to produce tungsten carbide powder. This is then mixed with cobalt and subjected to pressure to produce moulded blanks. The moulded blanks are then heated to a temperature which causes the cobalt to melt and cement the minute grains of tungsten carbide into a hard solid mass. This explanation is, of necessity, elementary. There are many refinements in the processes through which the materials pass, and at every stage of production the material is subjected to careful inspection, to control the quality of the final product.

The material may be likened to a stone wall where the stones represent the grains of carbide, and the mortar, the cobalt or cemented material.

Tungsten carbide possesses great hardness and also has great compressive strength and rigidity. But, just as the stone wall to which we have likened it, is strong and hard when properly supported, so it is with carbide.

Because tungsten carbide has no grain such as is present in steel or wood the direction of pressure must be carefully controlled. A stone wall will crack and break if pressure is applied in direction without opposite support because the stones are merely held in tension by the mortar. Material with grain, such as wood for example, will stand relatively high pressures because the grain running through the entire length is able to absorb and withstand the pressure.

For this reason, when applying carbides, never allow pressure to be exerted in such a way that the carbide is unsupported. A tool with a lip ground on the top surface of the tool, while quite usual when employing high-speed steel tools, is quite unsuitable for carbide tools. This in effect greatly increases the cutting rake, and thus changes the direction of the chip pressure. The absence of support in the direction of pressure will lead to early tool failure.

A tool which has been ground on the periphery of a grinding wheel and left with a concave front clearance will also lead to early breakdown of the cutting edge for the same reason.

A front clearance of 4 or 5 degrees, which has been found sufficient for general work provides full support to the cutting edge irrespective of the cutting rake applied.

The granular structure of tungsten carbide is also the reason why it is desirable when grinding Wimet tools for the grinding wheel to rotate INTO the carbide tool and not away from it. If the grinding wheel rotates away from the tool as shown in the lower pictures here, particles of unsupported carbide grains may flake off from the cutting edge leaving minute irregularities which can seriously affect the tool performance.

Let us now discuss the type of equipment which is required for the satisfactory reservicing of carbide, dealing first with grinding wheels and laps.

GRINDING WHEELS AND LAPS

Grinding is the cutting action of thousands of abrasive grains in the face of the wheel, which actually cut chips out of the work. Every grinding wheel has three physical characteristics :—

(1) The grains that do the actual cutting.

(2) The bond to hold the abrasive grains in place.

(3) The voids to provide clearance for chips cut by the abrasive grains.

Grinding wheels used for the grinding of high speed steel are not generally suitable for grinding Wimet, because the strength of this bond of this type of wheel is sufficient to hold the grains in position until they are blunted and the wheel become glazed.

It is known that a hack-saw blade in good condition will cut steel without generating undue heat in the material because the heat generated is in the chip. As the blade becomes blunted, however, and rubs without cutting, heat is generated in the material itself.

The same principles apply to the cutting action of a grinding wheel. While the abrasive grains remain sharp the wheel will cut without inducing undue heat. But the hardness of Wimet so quickly blunts these particles that unless the wheel is redressed it will generate excessive heat in the tip and cause hair-line cracks. The left, lower picture shows a wheel whose particles are worn as shown by the glazed appearance. The photomicrograph above the wheel shows the surface worn smooth and in need of redressing to remove the blunted particles. The surface of the wheel on the right is in good condition, being rough and sharp as illustrated by a similar photomicrograph. Both wheels have been used to grind tungsten carbide. What is the difference between them? It is the nature of the bond. The wheel on the right has a much *softer* bond so that the grains are dislodged during the action of grinding, immediately they become dull.

This continual breakdown of the surface (one could call it a self-sharpening action) presents new sharp particles to the tool enabling the removal of carbide without heat generation.

DIAMOND WHEELS

The search for the perfect cutting edge has been assisted by the development of diamond-impregnated wheels and laps. The photomicrographs show typical cutting edges produced by various methods. The length of the magnified portion which is seen is actually only 25 thou. so that the degree of magnification will be appreciated.

Diamond-impregnated grinding wheels are available with resinoid or metal bond. Resinoid bonded wheels have an exceptionally fast, cool cutting action, and are preferred for *machine* sharpening any type of tool, since grinding pressures are thus controlled. When used for *off-hand* grinding care must be taken not to groove the wheel.

Metal bonded wheels possess advantages of long life and resistance to grooving, and rounding of corners, and although their cutting action is slower than resinoid bonded wheels they are recommended for off-hand grinding single-point tools, because the variation in pressure arising from hand grinding can severely damage a resinoid bonded wheel.

LARGE OR SMALL GRINDING WHEELS?

Large diameter wheels are more economical when grinding or lapping, and are also much more efficient. The grinding area of a six-inch wheel with a one-inch grinding face is approximately sixteen square inches. The grinding area of a fourteen-inch wheel with a three-inch grinding face is approximately one hundred and four square inches, or about seven times the area of six-inch wheel.

Therefore, the heat generated during grinding is spread over a much greater area, and is more quickly dissipated, so that the wheel remains virtually cool during even continuous use. In addition, wheel wear is much less noticeable. In fact, larger wheels have been proved to outlast many more smaller wheels than would be obtained for the cost of the larger wheel, so that direct cost savings result from their use.

MACHINES FOR OFF-HAND GRINDING

There are many machines available especially designed for sharpening carbide tools accurately, rapidly, and economically.

For off-hand grinding the machine should be equipped with a tilting table, of ample size, that can be set at various angles by means of an easily read, graduated quadrant, and capable of adjustment towards or away from the wheel to compensate for wheel wear.

A protractor type work-holder or universal vice can be used on a fixed tool rest table to ensure the production of accurate tool angles.

Driving spindles should be free from vibration, end-play, or run-out, to prevent rapid uneven wear of the grinding wheel and unsatisfactory grinding conditions. Means for reversing the direction of wheel rotation enabling both right and left-hand tools to be ground by the same wheel is a necessary feature.

All machines for off-hand grinding should be fitted with a coolant system since a steady flow of coolant directed upon the face of the wheel prevents over-heating of the tool, keeps the wheel clean and free-cutting, and prolongs wheel life. A copious supply of coolant is always necessary because a trickle or intermittant flow results in alternate heating and quenching and generally results in cracked tips. If a good flow of coolant is not available it is better to grind dry.

Water, to which a little soda has been added, is preferable to soluble oil.

Now for the actual grinding procedure.

OFF-HAND GRINDING OPERATIONS

Rough Grinding

For the purpose of illustration we will describe the off-hand grinding operations from the preliminary rough grinding, through to final lapping. Starting with the preliminary rough grinding, first rough grind the required cutting rake on the top surface of the tip. This operation should normally be avoided to preserve overall depth of tool. Chipped or broken cutting edges will usually clean-up during the rough grinding of side and front clearances.

Next, grind secondary front and side clearance angles on the steel shank on an aluminium oxide wheel. The secondary angles should be 2 to 4 degrees greater than the clearance angles required on the tip and will prevent the shank contacting the wheel when the tip is subsequently ground on the silicon carbide wheel.

If the tool is required with a 4 degrees primary clearance, the grinding machine table should be set at say 8 degrees for secondary clearance. Now, using a soft-bond silicon carbide wheel, rough grind primary side clearance on TIP, followed by primary front clearance. Notice here how the secondary clearance produced at the previous stage enables the tip to be ground without the shank contacting the silicon carbide wheel.

Finally, rough grind nose radius, if required. Using the same soft-bond silicon carbide wheel as was used for the last operation, moving the tool in a radial movement as shown. It is important in all off-hand grinding to move the tool across the face of the wheel during grinding.

Finish Grinding

Now follows the finish grinding on the slightly harder bond silicon carbide wheel, or if preferred finish lapping on a metal bonded *diamond* wheel. When tools are withdrawn from work at the right time, finish grinding or lapping only is necessary to resharpen them for further use. The procedure is the same as for rough grinding.

The secondary clearances are of course not ground again. It should be remembered that in all carbide grinding operations, particularly when grinding free-hand, the *lightest* possible pressure should be used. Excessive pressure induces great heat in the tip, subjecting the carbide to thermal shock which may lead to minute cracking.

GRINDING PRIMARY RAKE

Primary and secondary cutting rakes are proving extremely successful in improving carbide tool performance, and the primary rake when required should be produced at the last grinding stage. The width of the primary cutting rake will normally be three to four times the feed, ground as a land along the cutting edge and at the angle required, with the secondary rake 4 degrees or more greater.

MODIFYING STANDARD TOOLS

Off-hand Grinding

It sometimes happens that jobs require tools of a shape not available in the range of standard tools, or the work may be of such urgency that although a tool of standard shape would suffice, such a tool is not carried in your firm's stock. In such cases it is usually possible to modify a standard tool to the shape required. Tools which have become badly chipped or broken in service can usually be modified to a new shape.

Select a tool which can be modified with the least amount of grinding and carbide wastage. An approach angle for instance need only be of sufficient length to accommodate the depth at which it is proposed to cut.

Some modifications, such as alterations to cutting rake, plan approach or plan trial angles, or clearances, are performed by off-hand grinding in the manner already described.

If a large amount of material MUST be removed, try to do this in stages, in order that a single face of the tool will not be subjected to continual grinding and thus high heat generation.

It will be necessary to relieve the shank material on an aluminium oxide wheel during the course of grinding the modification required.

Machine Grinding

More complex modifications may require the use of a tool and cutter grinder, surface grinder, or possibly a profile form grinder.

This form tool, with an internal radius, is produced from a standard bar turning tool, by machine grinding on a tool and cutter grinder. In this example, it is not possible to relieve the shank material on an aluminium oxide wheel, so both carbide and steel shank must be ground together. Set the tool in a universal vice at an angle to produce the desired clearance angles, noting carefully that the wheel must always grind into the cutting edge to avoid minute flaking of the carbide.

Grind downwards and outwards. This reduces the rate of wheel wear which is usually very high on this type of work, and for this reason it is unnecessary to form the wheel until the final shape is nearly reached.

If a precise form is required the wheel must be formed with a radius dressing attachment. Where limits of form permit, the wheel may be dressed by hand with a carborundum stick.

It is sometimes advisable when form grinding to finish with a slightly harder grade wheel in order that the finishing cuts may be carried out with as little wheel wear as possible.

Here's another example showing the modification of a standard bar turning tool to a parting and chamfering tool.

Set the tool in a universal vice at an angle to produce the required clearance angles, using an aluminium oxide wheel to grind away excessive shank material.

Then grind downwards and outwards with the unformed silicon carbide wheel until the point is reached where the radius is to be produced at the neck of the tool. Form the radius on the wheel in the manner previously described and finish grind.

The tool will then be reset in the vice for grinding the opposite edge and the same procedure carried out, ending with the chamfer produced by the formed wheel.

The tool shape has now been completed and it only requires the front clearance to be applied. This is performed by off-hand grinding in the same manner as described for the normal reservicing of tools.

GRINDING MULTI-TOOTH TOOLS

We shall now describe the grinding procedure for reamers, milling cutters and similar end-cutting tools. Such tools are always reserviced on tool and cutter grinders and for this purpose resinoid bonded diamond-impregnated wheels are recommended.

End Mills, etc.

Here, we show a spiral end mill mounted between centres. A spring-loaded finger attached to the wheel-head locates on the tooth being ground.

With a tooth resting on the finger, raise the table to obtain the desired clearance. Grind to remove between half-a-thou. to one thou. per pass, keeping the spiral flute in contact with the spring-loaded finger the while. Proceed until all cutting edges are sharp.

Next, lap end of tool.

The spring-loaded finger is now attached to the work-table as shown. Tilt the work-head to give the required end clearance angle and lap each tooth until all evidence of wear is removed.

Milling Cutters

The procedure for grinding milling cutters is outlined below. In each case the cutter should be indexed from blade to blade against the spring-loaded finger. Grind small, equal amounts from each blade until all are re-sharpened, and check for concentricity.

(1) Lap the faces of the blades, if necessary. Mount the cutter on the work-head with the blade face in the same plane as the face of the lapping wheel.

(2) Lap the diameter. Attach the finger to the wheel-head. Raise or lower the table to obtain the desired clearance.

(3) Lap the face. Attach the finger to work-head. Tilt the work-head to give desired clearance angle.

(4) Lamp the chamfer. Attach the finger to the table and adjust to give the correct clearance. Turn the work-head to 45 degrees and lap chamfers to the required width.

Now we come to the reservicing of a face milling cutter. With the cutter attached to work-head set at the required helix angle and radial rake, the face of each blade is lapped in turn. Swing work-head over to the required bevel angle, and with finger attached to work-head, adjust to obtain the required clearance. Lap bevel angle on each blade in turn.

With work-head at 45 degrees, finger attached to work-head and cutter at required clearance angle, lap chamfer on each blade.

Set work-head at 90 degrees less the amount required to give inrake or dish, with cutter tilted to required clearance, and grind blade clearance.

When should tools be withdrawn from service for re-sharpening?

Allowing carbide tools to operate until they become excessively dull consumes increasingly more horse-power for operating the machine, produces inaccuracies and an inferior finish on the work, requires more time for sharpening and causes rapid deterioration of the tool, often resulting in tool failure due to increased pressure and friction between the tool and the work. In addition, the more carbide that has to be removed during sharpening, the greater the danger of generating heat and forming cracks.

It is, therefore, in the interest of carbide tool users to withdraw tools from service for resharpening at the right time. Carbide tools should be sharpened as soon as they become slightly dull and before the cutting edges start to break down or crumble, or the faces begin to crater.

Tool life and reservicing should be regarded as a function of tool engineering. Operation sheets should state that tools should be removed from machines after a certain number of hours of operation, or after they have cut a fixed amount of work. The length of time, or amount of production, will be based on experience of tool behaviour gained from performance reports from machine shop and reservicing department.

Planned tool life and centralised reservicing such as this reduces the time spent on grinding and saves valuable carbide, since only a few thousandths of an inch need be ground from a slightly dull tool to obtain a clean sharp cutting edge. In addition, grinding wheel costs are reduced, and overall efficiency greatly increased.

"FIELDING" HYDRAULIC PRESSES FOR THE PRODUCTION OF PAVING SLABS, KERBS AND TILES

The extensive demands for concrete products have considerably increased, and, during our experience of upwards of a century, we have, in co-operation with the leading concrete manufacturers, developed a special range of presses for the production of paving slabs, kerbs, and tiles.

In designing these presses full consideration has been given to the arduous duty and conditions met with during service, and particular attention has been given to rigidity to ensure that they are capable of withstanding such conditions.

400 TONS THREE MOULD ACCUMULATOR OPERATED SLAB PRESS

Our latest presses embody considerable improvements with the result that we are now able, in addition to our well established type of plant, to offer modern self-contained units each with its own hydraulic pumping system and centralized control panel, and arranged with moulds for various purposes.

"Fielding" hydraulic presses have the distinctive advantages of low installation and maintenance costs plus ease of operation and high production rate.

The extensive experience of our Technical Staff is always available to give advice and guidance, also we should be pleased to arrange demonstrations on site to suit your convenience.

Edwards Contribution to Machine Tool Industry

Long experience in design and expert knowledge, plus skill and enterprise, have resulted in a valuable contribution to a branch of industry which is constantly seeking improved equipment. In this respect, the sheet metal industry has again been well served by F. J. Edwards Limited.

THE introduction of the *New Besco Production Guillotine Shearing Machines, Mark II*, to handle $\frac{1}{8}$" thick mild steel plate..means that all the modern ideas in sheet metal and plate guillotines have been perfected to give even more accurate cutting at top speed and maximum capacity. There are three sizes to cut widths of 48" (Model 48/10) 72" (Model 72/10) and 96" (Model 96/10).

The general construction consists of heavy cast ribbed sections, bolted and braced to constitute a unit of the strictest rigidity and eliminating at once any tendency to deflection. Being undercrank type, the weight and build is low, affording the greatest possible stability. The end frames are accurately squared with the bed and have a 2.$\frac{1}{2}$" gap to accommodate sheets of unlimited length for trimming. The bottom blade beam is provided with the necessary adjustments to bring the shear blades into correct alignment and it rests directly on the end frames. The top blade beam is guided in long slides in the end frames, gibbed to compensate for general wear, and is heavy and well ribbed. It is also spring balanced to the return to the top of the stroke, thus minimising wear on the breaking and clutch mechanisms. The automatic cam operated brake is designed to steady the beam on the down stroke, releasing on the up stroke and halting the beam in the top position. Strokes per minute are 50. The $\frac{5}{8}$" thick heavy alloy steel blades have four cutting edges giving straight, clean, accurate cutting.

Designed to give an uninterrupted view of the cutting line, the angular hold-down automatically operates when the treadle is depressed and is fitted with flexible pads for compensating its grip. It swivels clear to allow the easy removal of the blades. A stationary finger guard is mounted in front of the hold-down. Hold-down to blade edge is 1.$\frac{3}{8}$". The rear of the guillotine is enclosed by a steel chute or apron, which, if desired, will deliver the cut length of material direct into a truck.

The clutch is of the positive non-repeat dog type actuated by a latch box of special design (Patent Number 664342) and may be operated by air cylinder if required. The machine is intended for delivering single strokes, but adjustments to the latch box can effect continuous cutting. A treadle foot control pad is situated at each end of the machine, and to prevent accidental engagement of the clutch, a safety stop is fitted on to the treadle bar. The sliding clutch member is mounted on a splined sleeve which in turn is secured to the crankshaft. The clutch ring is carried on the hub of the 25" dia. spur gear which is mounted on a long bronze bush. When the treadle is depressed, springs force the jaws on the clutch into mesh with the jaws on the clutch ring. Disengagement is by cam and roller. Machined from nickel-chrome steel and hardened, the clutch will give long life and trouble free service.

The crankshaft is a carbon steel forging. The geared drive is on to the balanced flywheel through multi-vee belts from the 7.1/2 h.p. x 1500 r.p.m. motor, which is mounted on a platform on the left-hand side of the guillotine. All shafts, including the crankshaft, run in bearings with replaceable phosphor-bronze bushes. The flywheel and all gearing is above ground level and no pits are necessary.

Adjustable front gauges and bearers and standard back gauges, with ranges of 36" and 24" respectively, are provided with the machine.

Sheet metal guards enclose the gears and vee rope drive, yet all lubrication points are easily accessible.

Model 48/10 weighs 41 cwts, Model 72/10 52 cwts and Model 96/10, 65 cwts.

A very wide range of extra equipment is available for these machines, particularly some precision gauges for fine, accurate gauging.

1. A Special 36" side and front squaring gauge, which can be fixed to one end of the table. It is machined on the top face and has a rectangular machined bar for the squaring face. On this bar is a rule, graduated in 1/64ths up to 36". The stop moves over and along the rule to show the width being cut and thus acts also as a front gauge. The minimum width indicated on the rule is 4".

2. Precision back gauge consisting of two travelling heads, coupled together by a shaft. Each head may be operated independently for angular cutting, by uncoupling the shaft. The two guide bars of this gauge are graduated in $\frac{1}{64}$ths from 0"—24".

3. Similar gauge to above, but with independent movement of each head.

4. 24" precision back gauge to enable a setting to be obtained within 1/64th by direct reading on the rule, with an indexing peg in the operating wheel. It consists of two horizontal extensions bolted to the cutting beam, the gauge itself fitted to slides engaged on square threaded spindles which run in each extension. These in turn are operated by mitre bevel wheels coupled together. An indexing wheel operates the gauge and index positions, 16 in number, are coincident with $\frac{1}{64}$" on the rule and can be read up to 24". Slots are provided in the slides for angular or taper cutting.

5. A right angle mitre gauge to fit on the front gauge bearer. With settings at 30°, 45° and 60° for angular cutting.

6. A special side table extension with a squaring gauge fitted. Tee slotted along the entire length of the table to the front gauge. Table 72" long x 12" wide, fixing on the front of the bed with a floor mounting support at extreme end.

7. Two useful lighting units for illuminating the cutting line, for fitting to the top of the machines.

* * *

The series consists of twelve different models, all for hand operation and they are styled the *Besco all steel Universal Folding Machines, Mark II.* By virtue of the many adjustments, they are truly universal models, ideal for making round and sharp bends and folds, rapidly and accurately in mild steel sheet and plate, up to the maximum stated capacity of each model. Other materials such as brass, copper, aluminium, zinc, duralumin, stainless steel, etc., can also be handled in capacities proportionate to that of mild steel.

The method of construction makes these machines almost unbreakable, and as the tension bars and cross brace rods are all adjustable, the machines can quickly and easily be trued up, should it be subjected to severe strain and thrown out of alignment by over-loading.

The clamping beam is adjustable to suit various thicknesses of sheet, up to, of course, the maximum capacity of the particular model. Quick clamping is arranged by eccentric levers, one on each side of the machine, making it possible to clamp one end of the sheet to a prescribed line and then move the other end into position and finally clamping the whole sheet. This beam lifts to a height of 1.$\frac{3}{4}$".

The front folding beam is counter-balanced for ease of operation, by heavy weights on long arms each end of the machine. The weights are adjustable up and down the arms to give balanced operation. The beam itself is adjustable in the side arms for making true radius bends up to 1" with special formers. An adjustable stop is provided to control the amount of travel of the beam, for repetition work.

Narrow reverse bends in lighter gauge sheets are made by removing the detachable angle bar fitted along this beam which, on removal, leaves an edge of $\frac{1}{2}$" wide. An even narrower reverse bend is possible, again in light gauge sheets, by removing the auxiliary blade which lies behind the angle bar. This minimum return bend is $\frac{1}{4}$" on the two smaller models in the 14 and 16 s. w. g. series, while on the other eight models it is $\frac{5}{16}$".

The angle bar should be set to the lower position on the beam, to give full support along the beam when bending material to the maximum capacity in relation to the radius of bend. The actual rated capacity of each model is a 1.$\frac{1}{2}$" or wider flange in mild steel sheet.

Standard equipment includes normal blades on both the beams, plus the narrow auxiliary blade on the front beam.

The sizes in which these machines are available are as follows:—For 16 s. w. g. four models, 48$\frac{1}{2}$", 72$\frac{1}{2}$", 96$\frac{1}{2}$" and 120" wide. For 14 s. w. g. sheet, four models, 36$\frac{1}{2}$", 48$\frac{1}{2}$", 72$\frac{1}{2}$" and 96$\frac{1}{2}$" wide. For 12 s. w. g. sheet, four models again, in the same widths as for 14 s. w. g.

* * *

UNIVERSAL ALL STEEL MOTORISED SWAGING, WIRING AND JENNYING MACHINE

Built from heavy gauge steel plate, welded to form an extremely rigid unit, it is unbreakable and handles flat sheets, discs, cylinders and drums up to 14 s.w.g. mild steel, of 28 tons tensile with other metals in proportion. Twelve pairs of rollers are supplied for swaging, ogee beading, wiring and tucking, jennying, joggling and necking. Special rollers can be supplied as extras for flanging, crimping and beading, bottom closing and paning down operations. The machine is, in fact suitable for most operations on sheet metal requiring a rotary movement.

A moveable remote control foot unit instantly controls in either direction, continuously or momentarily, the movement of the rollers, and a guard plate prevents both the pedals being pressed simultaneously.

The top shaft is spring balanced and controlled by a capstan screw. The lower spindle has horizontal adjustment and is locked by two hand levers giving sensitive control of the alignment of the rollers with each other. The rollers are secured on the shaft ends by nuts, recessed flush with the outer roller face, enabling work to be turned up parallel to, or in contact with it. Centres of spindles measure 4" in the working position with $2.\frac{5}{8}''$ available for rollers. The speed of the rollers is 15 r. p. m. i. e. 15 feet per minute.

The E. 14 is fitted with a special gauge suited to the working of narrow strips as well as large cylinders and sheets, and is adjustable right up to the edge of the metal. The gap depth is $14.\frac{1}{2}''$ and from the frame to the end of the spindle is $17.\frac{3}{8}''$.

The $1.\frac{1}{2}$ h.p. $\times$ 1500 r.p.m. motor drive is through worms and phosphor-bronze worm wheels running in an oil bath with a visual oil-lever indicator. All spindles run in phosphor-bronze bearings and the high-speed first motion shaft in duplex ball-bearings. The rollers are the only moving parts exposed, but all parts are readily accessible. Working height from floor is $41.\frac{3}{4}''$ with $17'' \times 38.\frac{1}{2}''$ floor space. It weighs about 780 lbs. The design is registered 872119.

For home use, the normal electrical supply is 400/440/3/50, but electrical equipment suitable for all countries can be supplied.

For overseas casing, the gross weight totals 960 lbs. in a case measuring $42'' \times 23'' \times 58''$.

***   ***   ***

A NEW 70 TON PRESS BRAKE

70 tons is the maximum pressure exerted by this new *Besco Production Press Brake Model 125/70* at nearly the conclusion of its stroke.

This is designed and built by F. J. EDWARDS LIMITED. Its versatility makes possible such forming operations as bending and corrugating, beading, seaming and wiring, punching including notching, blanking and piercing; embossing and pressing. They may be executed either individually, progressively or in multiple, employing single or combination dies and attachments.

Apart from it's folding and forming capacities, punching operations to the extent of holes, slots or notches can be performed by using independent punching units in the required positions on a special bolster on the bed.

The bed and beam extend well beyond the side frames and enable trunk sections to be formed round the overhanging length; the side frames, out from the solid and open ended to a depth of 8" to accommodate sheets of unlimited width, have a clear space of $97.\frac{1}{2}''$ between them, permitting sheets to be passed straight through the machine, the overall bed length is 126". The entire front above the tool line is completely enclosed.

The carefully designed frame of heavy welded and bolted rolled steel plate constitutes a massive unit of the strictest rigidity, and is so designed that no load centres on a welded joint, all loads being transmitted equally through the centre line of the particular member and housing. The bed is solid with the main frame, is deep and of ample size to withstand top-capacity work.

The $4.\frac{1}{2}''$ adjustment to the top beam is not manual, but controlled by an independent motor of $2.\frac{1}{2}$ h.p. mounted on the right hand pitman. Both pitmans are arranged so that they can be adjusted independently to give equal pressure along the whole length of the beam. The stroke of the top beam is 3" and the maximum die space is $15.\frac{11}{16}''$.

(Continued on page 11)

Nassovia Cutter Sharpening and Rounding Grinder

RANGE OF APPLICATIONS

THE cutter-sharpening and rounding grinder Nassovia SR 1 is a tool grinder especially developed for the re-grinding of the Nassovia copy-milling cutters to be used in the copy-milling machines. Besides, it may be used as a tool grinder for re-grinding other cutters of similar type. This machine is the result of practical experiences and tests during many years and already has been proved with best results in many workshops.

By means of the cutter-sharpening and rounding grinder Nassovia SR 1 the following tools can be ground :

Single—and multi-edged cutters

(also end-cutting) such as Nassovia-Copy-Milling-Cutters.

Shank Cutters

Cylindrical—and cylindrical end-cutters

Tracers

CONSTRUCTION AND DRIVE OF THE MACHINE

The sturdy, suitably formed and welded column carries the grinding spindle head on horizantal guides, together with the drive-motor. On the extended ends of the motor shaft the grinding wheels are fixed.

GRINDING SPINDLE HEAD

The grinding spindle head can be adjusted longitudinally to the cutting feed by means of a handwheel and a scale. By another scale, it can be swivelled from the horizontal position at an angle up to 10° to the spindle axis, for grinding a clearance angle to the cutters.

LONGITUDINAL CARRIAGE

The column carries a saddle which, by a handwheel and spindle, can be displaced vertically in long narrow guides. This saddle has a longitudinal carriage running freely on balls in hardened and ground guides. The carriage has adjustable stops for limiting its maximal ways. On this carriage, an arm in ball bearings can be rotated up to 90°. A degree-scale with adjustable stops enables the operator to make an adjustment.

(Continued from page 10)

The 8 h. p. master motor is self-contained and carried on a platform at the top rear of the right hand side frame, with vee belt drive to the flywheel and thence through reduction gearing to the main crankshaft. The strokes per minute are 35, flywheel speed is 530 r. p. m. and load speed of the motor is 1440 r. p. m. Metal guards are supplied and fitted to all exposed drives.

The clutch is treadle operated, multi-dry plate friction type, with double helical teeth for silence, and the first motion gears run in an oil bath; an automatic brake stops the ram movement immediately the treadle clutch is released.

Levelling Strips conveniently fitted on the inside of the side frames are to assist installation on a true base and also engineers when setting revolving shafts in alignment. The machine stands 9 ft. high, with a floor space of $11'\,7'' \times 7'7''$. Net weight is 8 tons 8 cwts.

Back gauges can be supplied, reading from O" to 24", calibrated in 1/64", screw type, operated by individual handwheel. Each arm is adjustable horizontally left to right in the slotted bed.

The lubrication system is by means of a Tecalemit Hand Oil Pump and dial, situated on one side frame. One set of dies 10' 6" long with a 1" vee die opening is supplied with each machine. At the maximum, the total bed length of 126" permits a bend to be performed in a $10' \times 12$ gauge mild steel plate with a 7/8 vee die opening.

The following illustrates other forming capacities:— $8'' \times 10$ g. with a 1" vee die opening, $6' \times 3/16''$ with a 1.1/2" vee die opening, and $4'\,6'' \times 1/4''$ with a 2" vee die opening. Packing and casing for overseas requires a case of $147'' \times 87'' \times 114''$ with a gross weight of 9 tons 1 cwt.

***   ***   ***

WORKPIECE-SPINDLE-HEAD

The arm carries a small cross slide holding the workpiece-spindle head. This cross slide serves for grinding the radii out of centre of the cutter. For grinding conical cutters it can be inclined up to 10° from the horizontal direction. A 12 stop notched disc together with a scale permits the grinding of all possible circular pitches.

ADJUSTING DEVICE

By means of the adjusting device, the cutter edges can be centred to the swivelling axes and adjusted to the rounding on the end of the cutters. Besides, by fitting in a disc trueing attachment into the adjustment device, the grinding wheels can easily be trued.

TOOTH SUPPORT

A tooth support is provided for grinding spiral toothed cutters.

NORMAL ACCESSORIES

1 Tool-Chuck
1 Set of jaws (6 items)
1 Tool holder with screw
1 WINTER wheel dresser
1 Balancing mandrel for grinding wheels
1 Special socket wrench
1 Hexagonal pin wrench 5 mm
1 Double ended wrench 24-27 mm
1 Single ended wrench 41 mm
1 Square socket wrench 8 mm
1 Grinding wheel, cup form
1 Grinding wheel, plate form
1 Wheel holder for cup form wheels
1 Wheel holder for plate form wheels
1 Machine lamp
1 Copy of Operating Instructions

TECHNICAL DATA

Working range

Displacement of longitudinal slide about	140 mm $5\frac{1}{2}''$
Maximal grinding length of cutter incl. rounding	100 mm 4″
Maximal grinding length of cutter without rounding	140 mm $5\frac{1}{2}''$
Maximal radius to be ground	15 mm $\frac{5}{8}''$

Clamping range

Heigth of centres of tool head	106 mm $4\frac{5}{32}''$
Internal cone of tool head	ISA Steep cone 44
Maximal diameter of cutter to be ground	30 mm $1\frac{3}{16}''$
Minimal & maximal cylindrical cutter diam. to be chucked	6-16 mm $\frac{1}{4}$-$\frac{5}{8}''$
Power required	approx. 0.4 KW
Weight	175 kgs 386 lbs.

AN ELECTRO-HYDRAULIC DROP HAMMER

By Obering W. BRAUER, V. D. I.

ELECTRO-HYDRAULIC Drop Hammers were developed during the last War chiefly for use in the Aircraft Industry. They were principally engaged on sheet metal forming and shaping and had rather large table sizes. The maximum distance between the hammer legs was approx. 8′ $2\frac{1}{2}''$ with a corresponding depth of 3′ 11″ and max. daylight of 5′ 11″. The tup weight of such a hammer was 4 tons.

Based on the experience thus gained an oil-hydraulic drop-hammer for die-forging was developed, see fig. 1. Its method of operation and control are quite different from sheet metal forming hammers. For the latter hammers relatively low speeds of $31\frac{1}{2}''$ to $39\frac{1}{2}''$ per second were sufficient and the drop height was comparatively small, and considerably less than required for drop-forging hammers, for which the speed must be much higher in order to allow for rapid blows.

Tup weight for tup weight the energy required for drop-forging is very much greater than for sheet forming and the demands made on a drop-hammer are considerably stronger.

The basic design principles of the electro-hydraulic hammer are similar to a steam or compressed-air drop-stamp, i. e. the tup is lifted by the movement of a piston inside a cylinder and connected by a piston rod. In our case the pressure medium is oil. The diameter of the piston could, however, be kept much smaller by selecting a higher specific pressure and therefore the piston-rod itself could also be reduced to a minimum diameter.

The whole drive is mounted together in one enclosed unit containing the electric motor and the direct-driven oil pump. The cylinder pipe, all valves and sleeves are contained in one casting, see fig. 2. The design also permitted to do without all pipes and pipe connections, as it is a known fact that pipe connections do not stand up to the frequent shocks of a drop hammer. Only one aperture for the piston-rod exists in the top plate and all components are fitted from above so that the danger of leakages is completely eliminated. A simple but robust packing is provided for the emerging of the piston-rod and will last a very long time. In the unlikely event of a rod breaking, it can be replaced easily and quickly by a new rod without letting the oil run out.

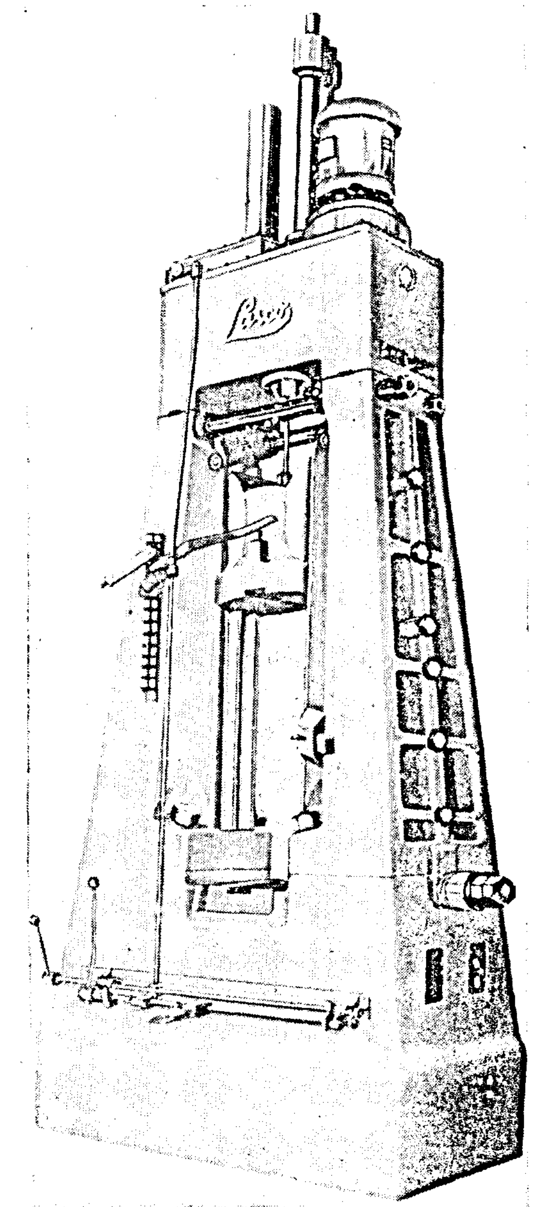


Fig. 1. Electro-oil-hydraulic Drop Forging Hammer with separate V V-guides.

An actual test has shown that a piston-rod can be changed is less than 30 minutes from stopping the motor and starting up again.

A number of reasons existed to select an oil-hydraulic drive. One of the chief reasons was the exceptionally

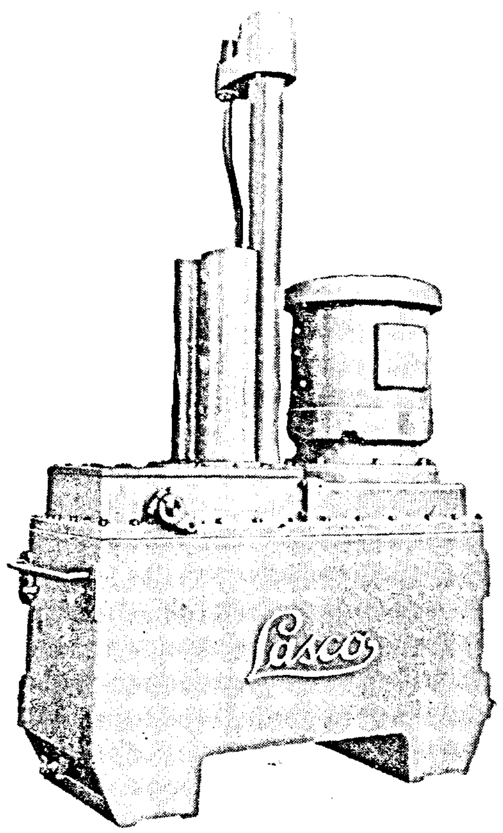


Fig. 2. Completely fitted hammer head.

efficiency of the pump, which was specially designed for this application, rather than rely on existing proprietary pumps. Such pumps with infinitely variable delivery, and suitable for a large output at high pressures were too large to be fitted into the driving head and it is doubtful if they would have been reliable enough bearing in mind the rapidly changing and substantial variations in pressure.

The lifting speed obtained by the oil-hydraulic drive is approx. 11′ 6″ per second. In view of this high speed special provision had to be made to store the oil temporarily during the process of acceleration instead of letting it blow off through safety valves. The lifting speed cannot be uniform over the whole stroke bearing in mind acceleration and deceleration. It reaches temporarily a speed which is considerably higher than calculated from the quantity of oil involved and piston area. This in turn has made it possible to avoid the chief disadvantage of all friction hammers, i. e. loss of energy during acceleration; on the contrary, it was possible to increase the speed of the tup and thereby the number of blows per minute.

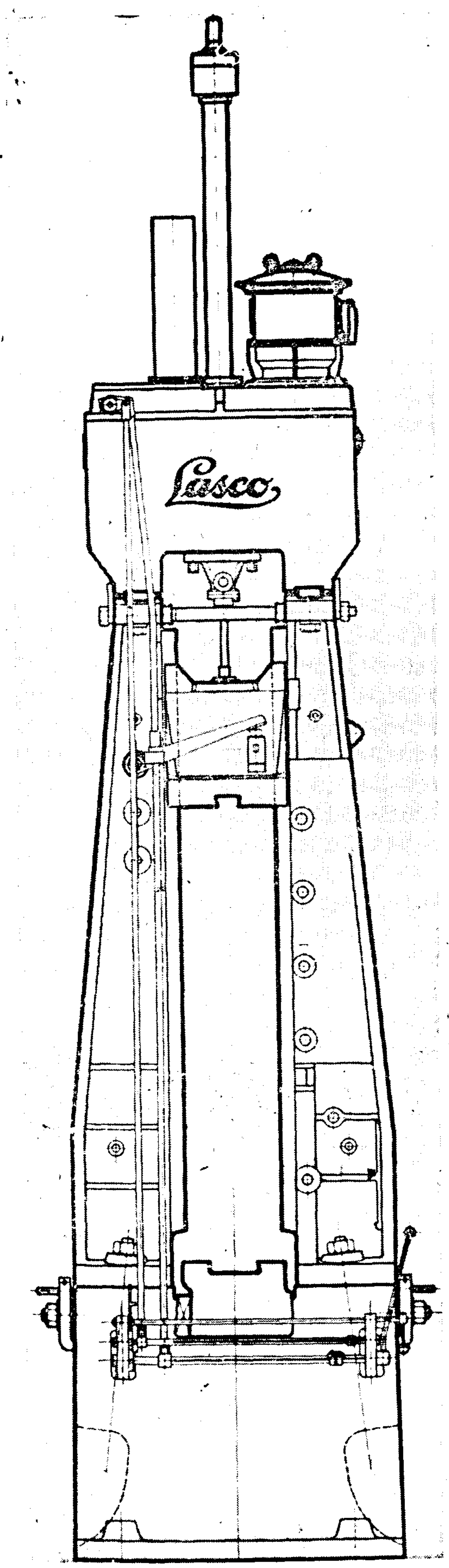
The lifting speed of belt—or board hammers is normally limited, as too great a speed will cause excessive wear and heating up of the driving gear which will render the functioning of the hammer uneconomical. In the case of the oil-hydraulic hammer the opposite applies, in fact it is even necessary to brake the rapidly rising tup by means of an air column in the cylinder above the piston, as otherwise the tup could not be stopped quickly enough after the oil feed has been switched off. As an example, a tup rising at a speed of 11′ 6″ per second would require a distance of approx. $24\frac{1}{2}$″ to come to rest, ignoring friction of losses, which are very low in view of the comparatively large clearances between tup and guides at the top and the thorough lubrication of piston and piston rod. This air cushion above the piston acts also as an accelerator at the commencement of the down stroke by gravity and increases the speed and energy of the blow.

Doubts were raised by experts that in view of the high dropping speed the oil could only leave the cylinder with great losses. Investigations were therefore made on the test bed at Coburg by the Investigating Branch Dept. Drop Forging, Hannover (Director Prof. Kienzle). The result was exceptionally favourable. The average impact speed was only 5% less than the theoretical maximum for a completely free drop. These 5% include the loss caused through friction between tup and guides. During these tests the top of the cylinder was left open in order to eliminate any possible assistance of the air cushion, above the piston.

In practice, the actual impact speed assisted by the air cushion is greater than pure gravity speed. This has been proved by actual experience in all cases where existing board or belt hammers were converted by the fitting of an oil-hydraulic driving head (see figs. 3 and 4). In these hammers anvil block and uprights remained unchanged. With identical drop height and tup weight a greater number of blows could be obtained together with a measurable increase of the strength of the blow so that the saving in stamping time amounted to 20%, to 30% and even 50% in special cases.

A further reason for the high impact speed is the automatic reversing at the bottom of the stroke, without using stops or other mechanical means.

The movement of the tup is reversed merely by the oil which comes to a full stop, i. e. its flow is fully arrested, as soon as the tup strikes. Therefore, the reversing can never occur prematurely and no excessive stresses can be



left: Fig. 3. A Board Drop Hammer converted into an electro-hydraulic Hammer.

set up in the hydraulic control or in the piston rod or in the connection between tup and rod. The reversing takes place irrespective of the height of the dies. It is a very import factor in the contribution to the great reliability of this type of hammer that the operator has no possibility to influence the setting!

The time during which upper and lower die are in contact with each other is therefore extremely short, which is of greatest benefit for reduced die wear.

The ability to control a hammer accurately and quickly is of importance for its efficient use, and a "one-man one-lever" control is provided. In order to obtain a blow of maximum strength and maximum stroke the single foot-pedal is pressed down sharply and released. The tup will drop instantaneously and revert automatically to its top position against a ratchet lever which is adjustable.

For short stroke blows the pedal is pressed down gently which causes the tup to drop slowly. The pedal can either be kept in the required position so that the tup

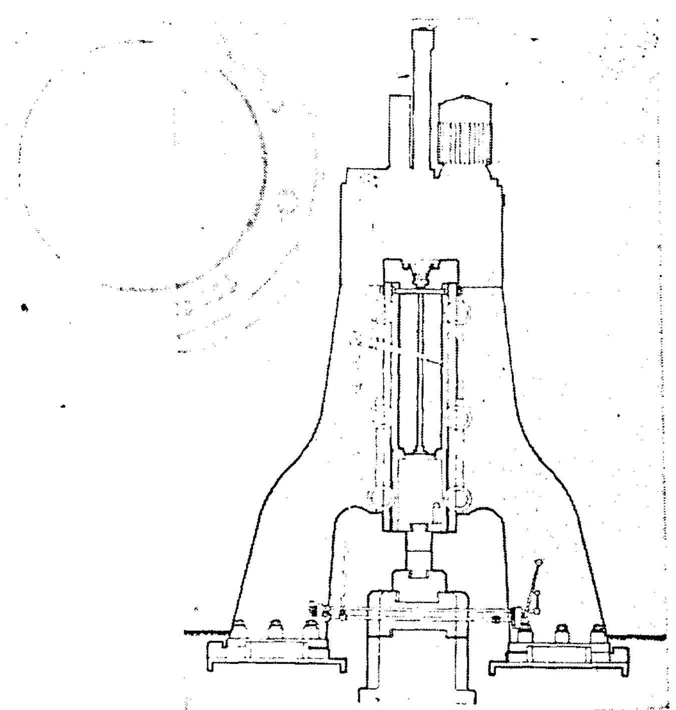


Fig. 4. A Steam Hammer converted into an electro-hydraulic Drop Hammer.

will stop, or alternatively it can be kicked through whereupon the tup will accelerate rapidly, strike and return to starting position. If further short blows are wanted, the pedal can be operated again whilst the tup is lifting. This will cause the tup to drop again from any required position.

Furthermore, if a workpiece has to be cut off the bar after forging the tup need only be lifted a few inches and can drop again gently to separate the forging from the bar. In all cases the tup always returns immediately to its top position after the foot is taken off the pedal.

If a forging requires to be straightened after trimming it can be put back into the hammer die and the tup can be brought down slowly until it comes to rest on the forging without making a blow strong enough to cause a further small flash which may be difficult to remove subsequently except by grinding.

As the process of drop-forging is not everywhere the same and different demands are made on a hammer a different control can be supplied on request which is automatic, similar to the modern board-hammer. With this type of control the tup will move up and down rapidly and continuously as long as the operator keeps his foot on the lever. When the foot is removed the tup will return automatically to its top position and stay at rest until the pedal is pushed down again. The foot pedal need not be fixed but can be moved along the floor, being connected to the control mechanism by a flexible pipe.

The hydraulic control is very easy to operate and saves the hammer operator from fatigue. It also renders a second man unnecessary as the whole range of performance is within easy reach of one man alone.

An additional hand lever is provided which acts directly on the main control shaft and which will be useful for the careful and sensitive handling and adjusting of the tup when changing dies. The tup can thus be raised and lowered slowly and accurately for die-setting and additional outside lifting gear is not required.

DISCUSSION

The discussion which followed the lecture brought to light several interesting points which are briefly mentioned below and which could be supplemented subsequently.

The largest tup weight was stated as 50 cwt but can be increased to 5 tons and more.

Regarding the control lay-out it was pointed out that the first sheet metal forming hammers as used in the Aircraft Industry were provided with electric push-button control which was adjustable as to height, so that by merely pressing a button by hand or foot continuous blows could be given from any height.

The number of blows of oil-hydraulic hammers is very high due to the very great lifting speed and down-stroke acceleration through the air cushion. 40 to 60 blows over the full length of stroke have been obtained for larger hammers, whilst smaller hammers have given 80 to 110 short stroke blows/minute.

Energy consumption is low due to the very efficient working of the pump which is between 0.8 and 0.85. A 20 cwt Hammer has a 22 kw motor but its actual energy requirements are only between 13 and 15 kw. The energy required by comparable hammer size driven by compressed air is considerably higher, by several multiples.

Another question raised the problem of impact speed, i. e. losses caused by the oil column. The favourable results could only be achieved by adopting a design which corresponded less to the principles of oil pressure control, but more to the principles of oil flow which apply to the high speeds which are obtained.

The question is existing hammers could be fitted with the oil-hydraulic drive could be answered in the affirmative. Figs. 4 and 5 show conversions of old-type drop-hammers.

The smallest tup weight for which hydraulic drive is economical is normally 16 cwt, although smaller hammers of 10 cwt capacity have been built.

WARD STAYBOLT AND FUSIBLE PLUG LATHES

WHILST Messrs. H. W. Ward & Co. Ltd., Birmingham manufacture a wide range of standard Capstan and Turret Lathes for general use in locomotive workshops, they have also developed a number of special machines for the production of Firebox and Roofing Staybolts and Fusible and Washout Plugs.

The machine shown in Fig. 1 is a No. 7 Staybolt Turret Lathe specially designed and equipped for producing roof or crown staybolts from steel bar or forgings and it will handle staybolts up to 1.3/8" diameter by 34" long.

When required for making staybolts from bar, the machine is fitted with a hand or air operated bar chuck with a far feeding arrangement that will accommodate bars up to 12' 0" long. It is recommended that all bars, which can be black or bright drawn are reeled before they are used.

The undercut portion between the two threads machined with a special double throw roller steady running toolholder that has eccentrically operated slides for quickly setting the rollers and cutting tool. Before this toolholder is used another special roller toolholder produces an undercut wide enough to allow the rollers and tool of the turning toolholder to be set at the required reduced diameter.

The threads are cut simultaneously with two self opening dieheads. One is mounted on the turret face opposite to the cut away in the turret for the second diehead that is mounted on an extension barrel that can be set to cover varying lengths of staybolts, there is also a graduated dial for setting the two dieheads in pitch. To ensure that the dieheads cut accurate threads, the turret saddle has leader screw control. The lever that engages the nut with the leader screw can be seen on the left hand side of the turret, shown in Fig. 2.

When one end of the staybolt has a taper thread, a diehead with a taper threading attachment is used for producing the thread.

Production times for four types of roofing staybolts are given in Fig. 3, these include staybolts made from bar and forgings. The times cover for the use of Tungsten Carbide tools for all turning operations and high speed steel cutters for the forming, screwing and parting of operations.

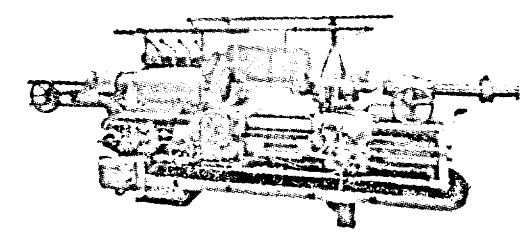


Fig. 1. No. 7 Staybolt Turret Lathe equipped for producing roof staybolts from bar.

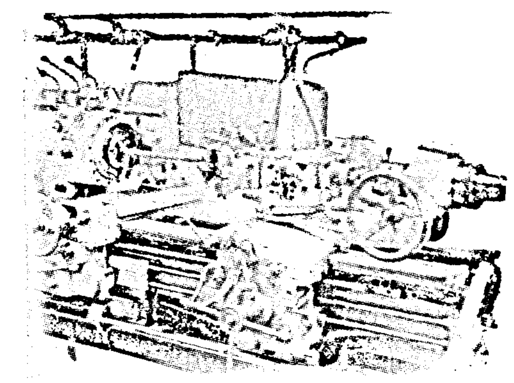


Fig. 2. View of Turret Toolholders and Duplex Diehead Bracket on No. 7 Staybolt Lathe.

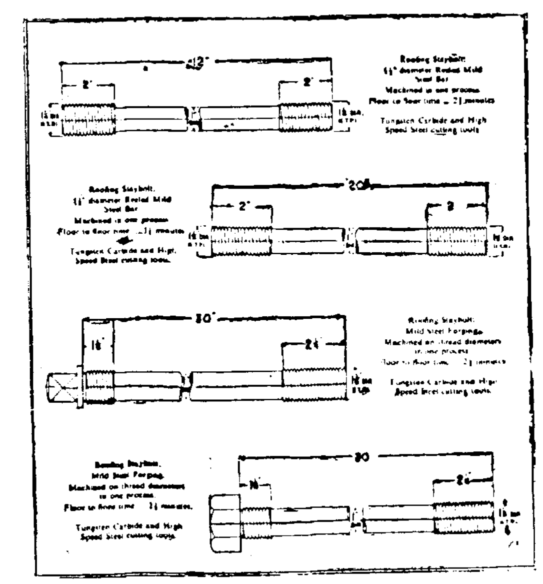


Fig. 3. Group of Roof Staybolts with production times.

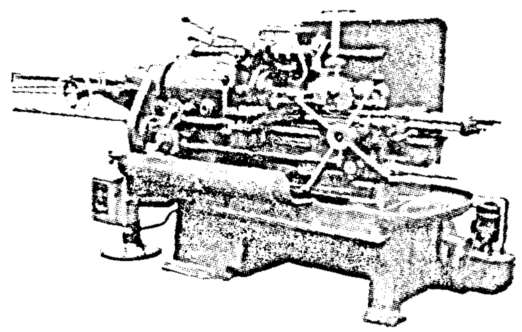


Fig. 4. No. 3A Staybolt Capstan Lathe with tooling equipment for machining Firebox Staybolts.

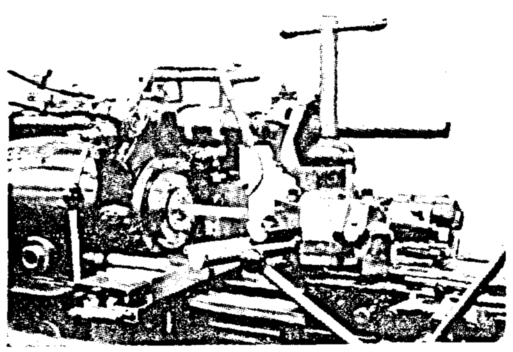


Fig. 5. View of air bar chuck with overhead leader screw and tooling equipment.

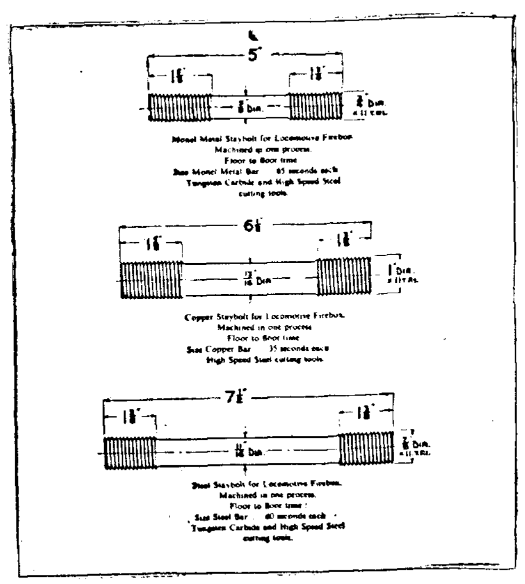


Fig. 6. Production times for Firebox Staybolts on No. 3A Staybolt Capstan Lathe.

The No. 3A Staybolt Capstan Lathe shown in Fig. 4 is equipped for manufacturing firebox staybolts. This lathe will deal with staybolts up to 1.3/8″ diameter × 10.1/2″ long when made from either copper, steel or monel mental bar.

The machine is fitted with an automatic bar chuck which can be of the hand or air operated type and the bar feed arrangement will handle bars up to 13′ 6″ long.

A special roller steady turning toolholder is used for turning the reduced diameter between the threads. This holder has a lever operated tool slide and carries rollers that are in advance of the cutting tool and steady on the outside diameter of the bar.

A close up view of the tooling equipment can be seen in Fig. 5 and on the turret face carrying the adjustable stop can also be seen a special cone that is used for spinning the end of the copper bar true before machining commences. Underneath this is a "catcher" for collecting the finished staybolt when it is parted off.

To ensure that the threads are in continuous pitch the self opening diehead is controlled by an overhead leader screw, the nut for engaging with this is carried in a bracket on the top of the hexagon turret. The leader screw cannot be seen in the photograph as it is covered by telescopic guards; it is conveniently driven by gearing from the lathe spindle. When different pitch staybolts have to be machined, the leader screw and nut can be quickly changed.

The lathe has a specially designed large capacity swarf pan and it is possible to remove all swarf from the rear of the machine without interferring with the Operator and affecting production.

Fig. 6 gives floor to floor times for three sizes of fire box staybolts when made from monel metal, copper and steel bar.

The machine shown in Fig. 7 is a No. 7 Capstan Lathe specially arranged and equipped for the production of fusible and washout plugs.

A hand or air operated two jaw chuck with vee shaped jaws is used for gripping the gun metals castings on the squared head.

All the machining operations are effected by toolholders mounted on the turret of the capstan slide and it will be noted from the photograph, Fig. 7 that the machine is not fitted with an intermediate saddle.

When the machine is set up for producing fusible plugs, the first operation is to start drill and cone the end, this is followed by a combined drilling, ending and step turning operation. A special taper turning toolholder that can be clearly seen in Fig. 8 turns the taper thread diameter and also the small taper step at the front of the plug.

The undercut at the back of the thread is produced by an automatic recessing toolholder that has a cam actuated toolhoder whereby the cutting tool passes through an angle of approximately 90° to produce the required depth of undercut.

A ground thread tap held in a releasing tapholder is used for tapping the internal thread and this is mounted on the fifth turret face.

The last operation consists of cutting the taper thread and this is done in one cut with a 2″ self opening diehead that has a taper threading attachment. To enable this diehead to rotate over the top of the capstan slide, the machine has an increased height of centre.

The sequence of operations to produce taper washout plugs is similar to those above, but instead of the drilling, coning and tapping operations, the plug is only centre drilled. This centre hole forms the location and abutment face for the revolving centres in the taper turning and undercutting toolholders.

Floor to floor times for three sizes of plugs are given in Fig. 9 and include for using Tungsten Carbide tools for the turning operations.

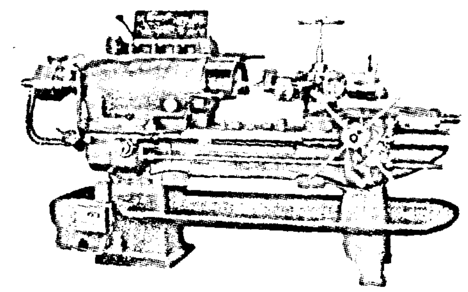


Fig. 7. No. 7 Fusible Plug Capstan Lathe fitted with air operated two jaw chuck.

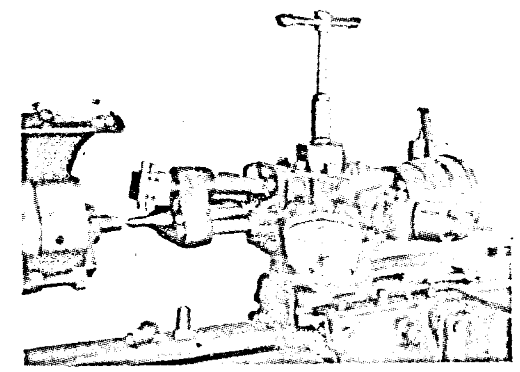


Fig. 8. View of some of the special toolholders for producing Fusible Plugs.

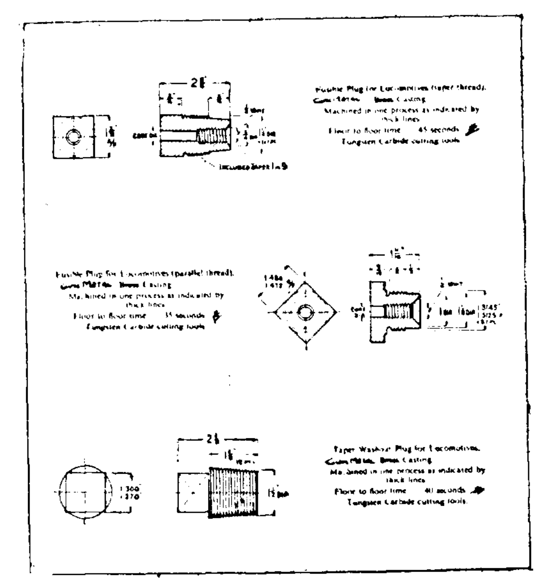


Fig. 9. Three types of Locomotive Plugs with machining times.

AUTOMATIC FLASH BUTT WELDING MACHINES

AUTOMATIC Flash Butt Welding is undoubtedly the procsss of "perfect Welding" in that the parts are truly forged in a manner comparable with the power hammer, of blacksmith's weld. The principle of this method is shown in Fig. 1. The two parts are clamped in the jaws or vices of the machine, which in turn are connected to the transformer, the one jaw being fixed and the other movable, mounted on a slide, through which the forging or upsetting pressure is applied.

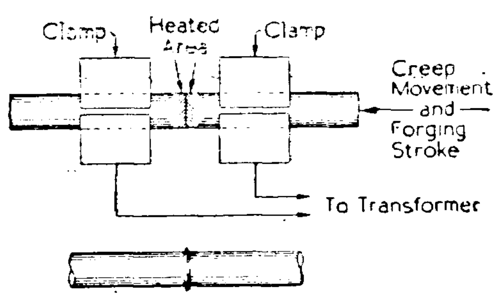


Fig. 1. The principle of Flash Butt Welding.

Simultaneously with the current application a very light pressure is applied to the moving jaw, causing an arc between the contact faces of the metal. The heat generated from this arc is so intense that it burns away the end faces uniformly on both sides, so that if the arc is maintained by a "creep" action of the moving jaw, a high temperature is rapidly obtained, the current is them switched off and the creep movement transformed instantly into a sharp blow, this action forging the plastic, or weldable metal and giving a homogeneous joint.

Automatically controlled machines operate on mass production lines and are capable of giving a high rate of output.

An automatic general-purpose flash-butt welder is shown on Figure No. 2. This machine uses compressed air at a pressure of 80 to 100 lb. per sq. in. and has a patented automatic control which can be set to give any desired welding conditions for the work in hand so that it is possible to pre-set the flash distance, upset distance, flashing time and upsetting pressure to suit any particular assembly within the capacity of the machine without the interchange of any parts in the control system, a simple adjustment of the indexing system being all that is necessary to give the correct welding conditions.

The machine is suitable for the high speed flash-butt welding of medium-light assemblies not only for quantity production but also for those conditions where a variety of assembly operations are required in the production programme.

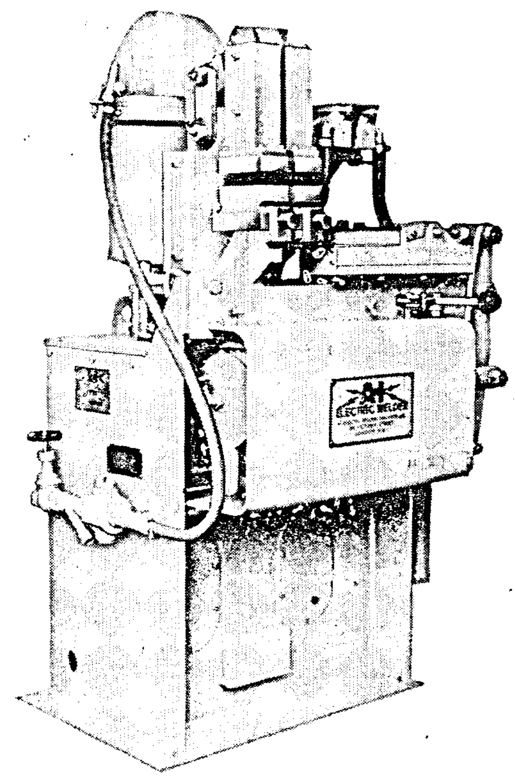


Fig. 2. A.F./1 Automatic Flash Butt Welder.

An example of an automatic flash-butt welder specially designed for the welding of light alloy cycle rims is illustrated on Fig. No. 3. In the past, the flash-butt welding of light alloys presented many problems, but these have now been successfully overcome and the machine shown has been designed to give high-class quality welding results coupled with a high rate of production. A patented system of control incorporating Ignitron Contactor Switchgear is fitted, as very accurate timing of the weld cycle is essential, the actual weld time being so short that it is measured in cycles.

Similar machines of this type have been supplied to handle other light alloy welding applications, such as the flash-butt welding of light alloy window frame

sections, etc. As the welding times are so short, the output depends almost entirely upon the rate of loading and unloading.

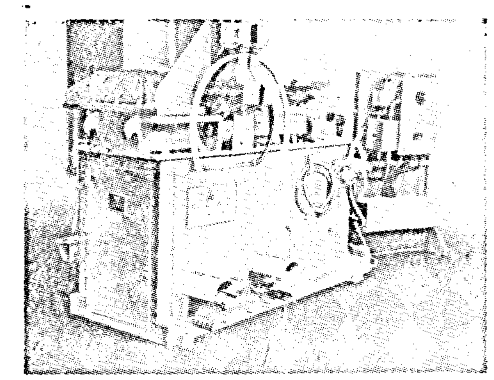


Fig. 3. A-1 Automatic Flash-Butt Welder for Light Alloy Cycle Rims.

To meet the demands of industry for the increased production of automobile wheels, tractor rims and the like, the automatic flash-butt welder shown on Figure No. 4 has been developed. This machine is capable of giving an output of 750 KVA and is able to handle rims up to 14 in. wide by .187 in. thick, and from 14 in. to 36 in. diameter, and therefore should be of particular interest to all firms engaged in the manufacture of wheels and where basic costs of quantity production are a prime consideration. Air-oil intensification has be incorporated in the clamping and forging units, giving exceptionally rapid action in clamping and inclamping. A fully automatic cycle is given from the commencement of the clamping operation until the rim is ejected from the electrode dies at the termination of the weld cycle. The actual welding time is 2 seconds, whilst the automatic features involving the progressive clamping, welding, unclamping and ejection of the rim result, in a total floor to floor time of 6 seconds when welding average-sized rims.

Ignitron contactor equipment has been incorporated, thereby eleminating the problem of maintenance which is so serious on high-speed machanical contactor switchgear.

The welding of steel rails is becoming increasingly important. The system has long passed the experimental stage and there appears to be no doubt that the system will be increasingly used throughout the world. The advantages of greater safety combined with smoother running as well as less wear and tear upon the

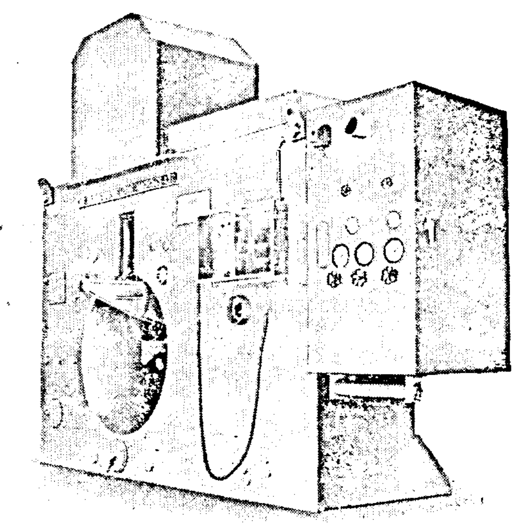


Fig. 4. 750 KVA High Speed Automatic Flash Butt Welder for Steel Rims.

rolling stock can only be achieved by having accurately aligned rails which are perfectly welded and afterwards normalised to ensure that the crystal structure and physical properties of the finished rails are consistent throughout their length, for we must never lose sight of the fact that every inch of rail is subjected to load and stress conditions, a state of affairs which is not usual with welded components.

The illustration given on Figure No. 5 shows an automatic rail welder capable of welding main line rail sections up to 131 lb. per yard. Such rail welding machines have been installed in many parts of the world. Horizontal and vertical adjustment is provided so that the rail surfaces are perfectly aligned even when under

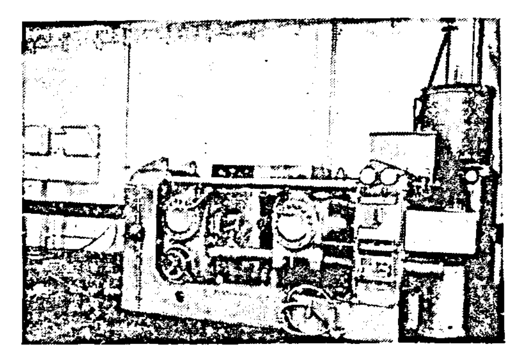


Fig. 5. A. I. Patent Automatic Rail Welder. (Machine in Operation at Netherlands State Railways Utrecht Depot)

full clamping pressure. Central loading gives equivalent distribution of the upset pressure over the entire rail section. The clamping arrangements for such large sections must necessarily be substantial and on these machines duel clamping is employed, a heavy horizontal clamp action being applied to the rail web whilst the current application is given by compensating clamps of the vertical type, requiring only the pressure necessary to maintain efficient current contact.

Automatic control governs the pre-heating, flashing and final forging of the rail sections, the special feature of this control system being that the pre-heating application is compensatory for the contact surface conditions of the rails, a factor of importance in rail welding technique.

"A. I." Post Heating Equipment for normalising the flash-welded rail joints is built in two models, stationary and portable. The rails are normally fed from the Rail Welding Machine into the Post Heater where the rail joint is automatically normalised by raising the temperature to 850° c., the temperature being automatically controlled by means of an optical pyrometer unit.

The clamp equipment is of the air-oil intensifier type which secures high efficiency in current contact conditions.

Another extremely interesting automatic Flash-Butt Welder is the machine shown on Figure No. 6 which is specially designed for re-ending the tubes from locomotive boilers. As is well known when tubes are

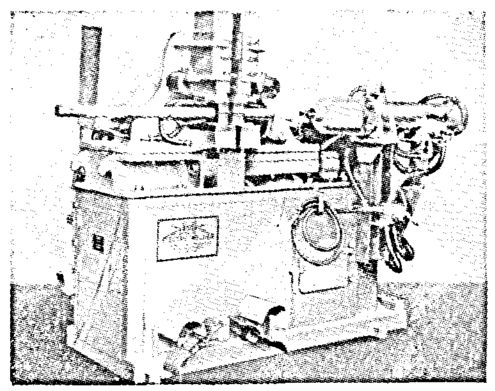


Fig. 6. A-I Automatic Flash-Butt Welder With Tube Stripper.

withdrawn from a locomotive boiler the ends are not suitable for further service. These re-ending machines enable the old ends to be removed and new ends to be flash-butt welded in a matter of seconds. The clamping and upsetting machanism is air-operated whilst a stripper unit is provided to remove the inside weld extrusion from the tube. The welder is rated at 100 k VA and is suitable for tubes up to 2¼ in. diameter.

A larger model of similar general construction is manufactured for superheated flue tubes up to 5½ in. diameter.

The various patented Automatic Flash-butt Welding Machines described in this article are manufactured by A. I. Electric Welding Machines Ltd., London.

We invite technical articles on the various stages manufacture of Machine Tools and Pneumatic Tools and any technical problem confronting the trade for publicity purposes.

Economical Efficiency of Double Acting Swage Forging Hammers versus Conventional Drop Stamp Hammers

By V. SMEISER

ONE of the principal aims of applied Mechanical Laws is to achieve a maximum effect with a minimum effort and thus to attain more economical efficiency, irrespective of work involved.

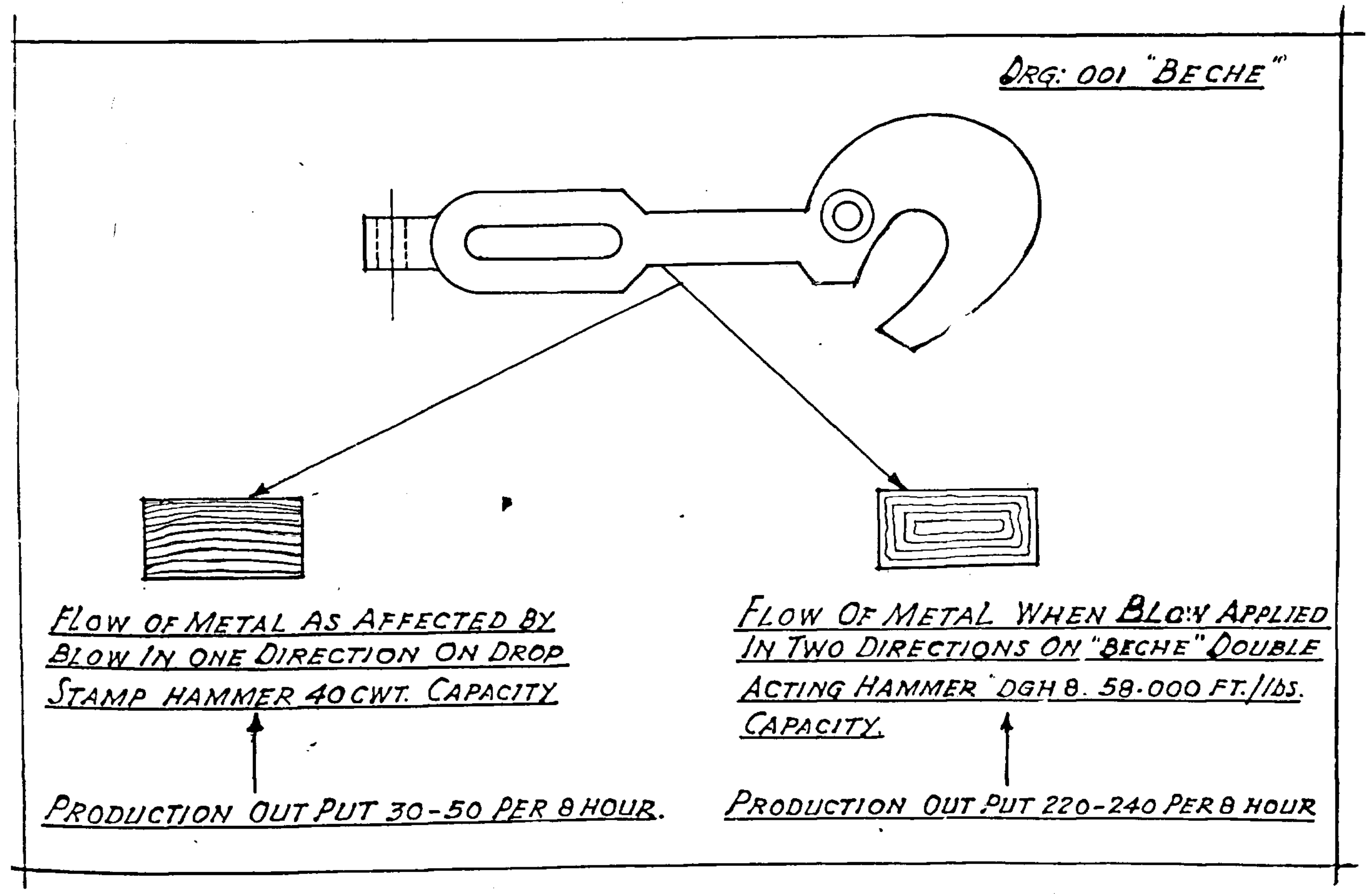
Whilst this aim had been eagerly followed up everywhere in the metal cutting machine tool line, the same had not been so carefully exploited by works engineers in the case of swage forging plants, which have always been, and are still to-day, the neglected department in many workshops.

The reason for this policy may perhaps be due to the fact that most of the engineers connected with production of components from die forged steel do not care to consider the swage forging operation sufficiently important, and, therefore, in many instances wrong equipment and wrong methods are applied in the process of swage forging.

Such practices will inevitably affect the production output as well as the quality of dieforged products. After all, swage forging represents the first step in the sequence of a number of machining operations, and, therefore, should be treated on equal level with any subsequent milling, boring, turning or grinding operation, whichever of them may be required to finish the dieforged component.

In order to improve the production output and the quality of swage forgings, Messrs. Beche and Grohs G. m. b. H. of Huckeswagen, Germany, have developed their line of Double Acting Hammers to such an extent that their Counter Blow Principle is to-day recognized by all modern smithy shops as leading swage forging method.

The above drawing indicates the difference in the flow of material and production output in the



manufacture of railway draw hooks as obtained on Conventional Drop Stamps of 40 cwts. capacity and BECHE Double Acting Hammer Model DGH-8 of 58000 ft./lbs. capacity. The production data was taken as an average output obtainable on equipment already installed in India.

No doubt, not only every engineer but even laymen will appreciate the possibilities of larger output and better flow of forged metal as can be achieved on double acting hammers.

The idea of counter blow principle originated firstly from the necessity of avoiding the vibration of the blows, transmitted through the foundation in the case of conventional drop stamp hammers, and secondly to utilize the available effect of blow to maximum capacity, without the use of unusually large anvils, which are impracticable for transport and cumbersome during installation.

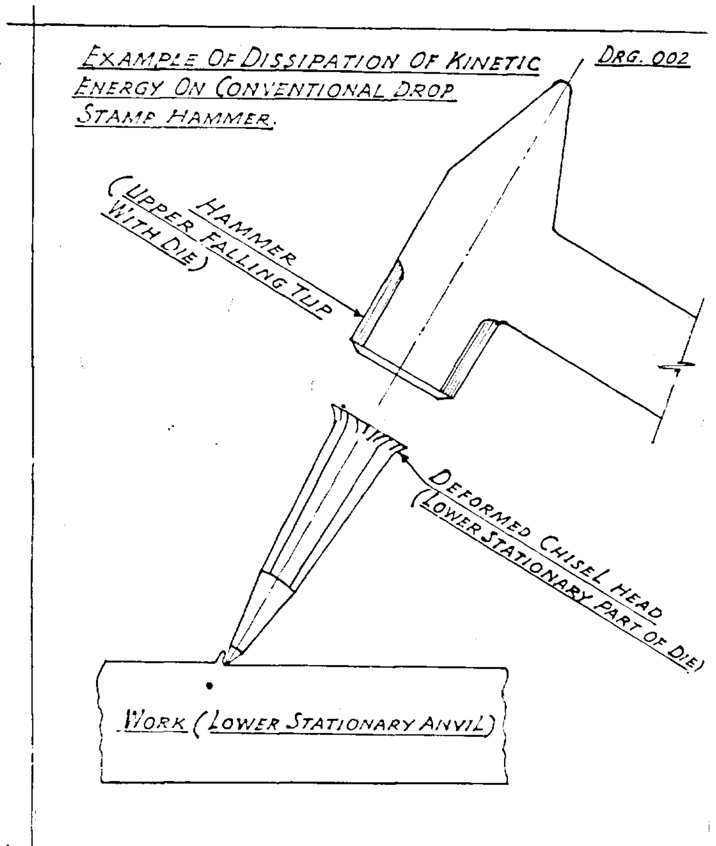
Another important point, which has also had to be pursued during the years of development, was to render increased life to the forging dies.

It is a well-known fact to smithy engineers that dissipation of Kinetic energy, produced on falling tup meeting the lower anvil, primarily affects the life of forging dies, because in case of conventional drop stamps, only one part of die is a moving factor. The dissipated Kinetic energy usually affects the lower stationary die in a similar manner as a chisel head gets deformed under the impacts of a hammer.

If it would be possible to move both the chisel and the hammer against each other at same speed, on their meeting the deformation of chisel head could be prevented to a considerable extent, just the same as the life of forging dies is prolonged when used on counter blow system.

To explain further the advantages of Double Acting Hammers over the Conventional Drop Stamps, I wish to outline briefly both the afore mentioned practices.

1. The conventional drop stamp hammers operate on a principle wherein the upper falling tup of a certain given weight is lifted to a certain height from where the same is



dropped by gravity in order to obtain the required effect of blow.

The capacity of the drop stamp hammer, therefore, is derived from the weight of the falling tup multiplied by the height from which the tup is dropped. The following formula is generally applied:

Falling tup weight plus weight of top die multiplied by falling height—mkg (or ft./lbs.) less 10% frictional losses.

The above formula, however, covers the approximate theoretical capacity of the drop stamp forging equipment per each single blow only and since the output of the dieforged components depends mainly on the frequency of the blows or the so-called effect of blow per second, actually a formula according to the following example should be considered.

Example: A conventional drop stamp of 7 cwts. has a falling weight of approximately 450 kgs. (comprising 350 kgs. of tup weight and 100 kgs. of top die weight). The dropping height is 1.5 metres (about 5′) and thus the effect of blow is:

450 kgs × 1.5 metres = 675 mkg, less 10% dropping frictional losses.

Total theoretical effect of blow is the equal to 615 mkg per each single blow. The maximum number of blows obtainable on a 7 cwts. drop stamp hammer is upto 40 per minute. Therefore, the maximum theoretical working effect of blow per second is equal to:—

$$\frac{40 \times 615 \text{ mkg}}{60} = 410 \text{ mkg (per second) OR } 2972.5 \text{ ft./lbs. per second.}$$

It must also be noted that from the above mentioned theoretical effect of blow per second, approximately 30 to 40% is absorbed by the stationary anvil and hammer foundation and, therefore, only 60 to 70% of the available theoretical effect of blow is actually transmitted into the workpiece.

2. The Beche double acting (counter-blow) method represents a system wherein both the lower and the upper tups are used as striking factors. They move coupled together and strike against each other in order to achieve the maximum effect of blow. The impact capacities of this type of hammers, i. e. the kinetic energy developed on the two tups meeting, range from 2000 mkg (14500 ft. lbs.) in the case of the smallest Beche double acting hammer and upto 1,25,000 mkg (9,06,250 ft./lbs.) in the case of the largest Beche double acting hammer so far built.

The lower and upper tups are driven against each other at the same speed, resulting in no losses on their meeting and the swage forging operation on the double acting hammers will, therefore, need essentially less mkg (ft./lbs.) striking power, and consequently, less number of blows than as required under the stationary anvil block type of hammers of similar mkg capacity.

The drive of Beche double acting hammers may be effected either by steam or by compressed air pre-heated to 160° C. The velocity of the blows is controlled through a hand lever operated valve gear, thus enabling application of light touching or heavy racking blows, according to particular swaging work requirements.

Steam or compressed air, whichever is used as the driving factor, is conducted upon the top surface of upper tup piston for actuating the blow and under the same piston for separating the anvils.

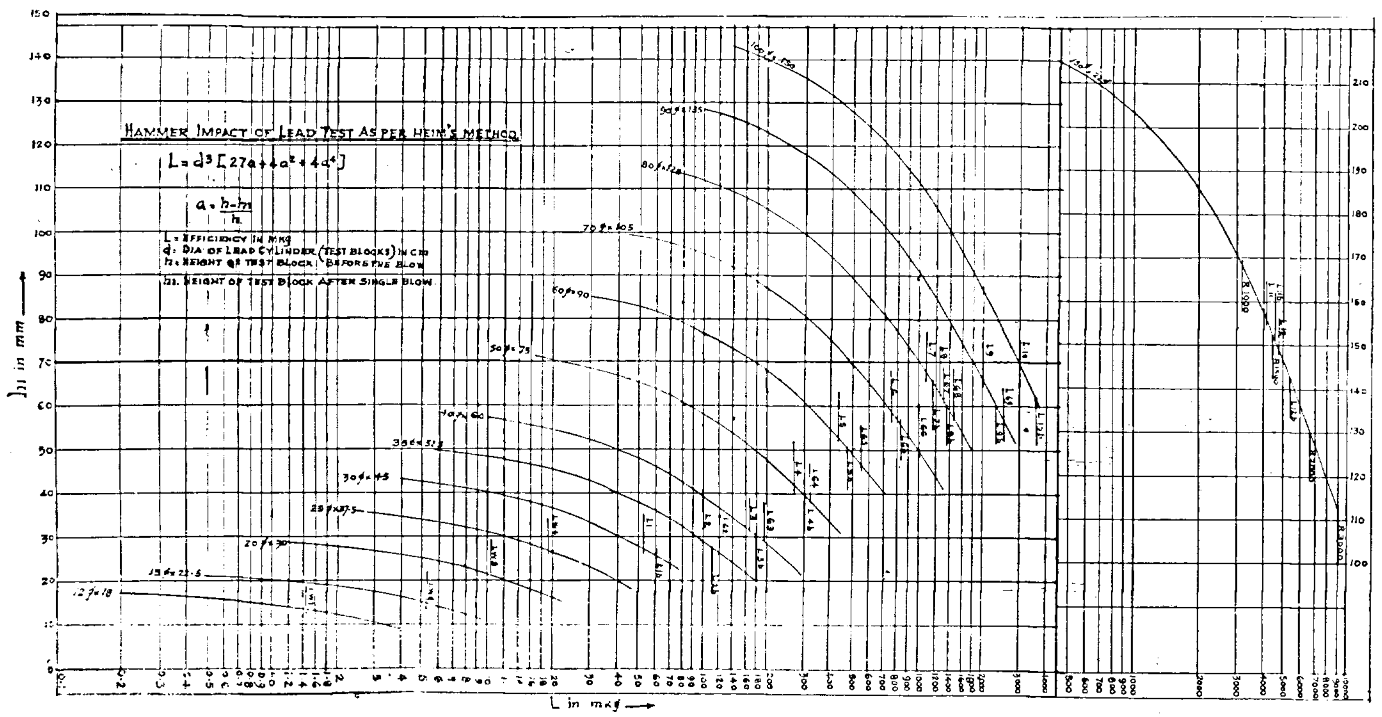
When effecting the blow, the lower tup (anvil) is drawn upward against the upper tup by means of a double sided coupling and thus accomplishing the counter-blow. On the return stroke, the lower tup drops down by its own weight, assisting thereby the rising of the upper tup.

The tups of Beche double acting hammers, upto 30,000 mkg capacity, are coupled mechanically by means of steel bands passing over pulleys. The steel band coupling consists of 20 to 30 steel plate leaves, each about 1/32″ thick. Normally 3 to 4 of these leaves would be sufficient to operate the hammer but for safety's sake and also for long life of the coupling, a larger number of leaves is used. The design of the mechanical couplings is illustrated in fig. 1 of the attached bulletin.

Beche double acting hammers over 30,000 mkg are provided with hydraulically operated couplings. With this system, plungers leading from the left and right hand sides of the upper tup on downward movement are immersed into oil cylinders. The displaced oil is transferred to the plunger of the central cylinder and by driving the same, the bottom tup moves upwards against the upper tup to accomplish the counter-blow.

To economise on consumption of steam or compressed air, the Beche double acting swage hammers work on the expansion principle. By this method a saving of about 40% is possible as against the system of Full Pressure. During the forging operation, because of the counter-blow principle and the pressure factor, dies on Beche double acting swage hammers are under constant pressure and, therefore, re-coiling of the tups is completely eliminated.

Apart from better production output, the most outstanding of the many advantageous features of the Beche double acting hammers is the elimination of the heavy anvil block and the reduction, consequently, of



the required foundation. Beche double acting hammers need only approximately one eighth of the size of foundation as may be required by a similar capacity drop stamp hammer.

The economical efficiency of Double Acting Method can best be proved by submitting the double acting hammers to Heim's Lead Cylinder Test, as utilized for measuring the capacity of Pneumatic hammers. The principle of this test is shown in the enclosed diagram.

Before concluding the paper, I would like to review the main features of the double acting principle.

(1) Possibility of installing double acting hammers on soil where otherwise conventional drop stamps could not be erected.

(2) Low cost of foundation

(3) High production output

(4) 4 to 5 times longer life of forging dies

(5) Possibility to control the effect of blow at will, i. e. to apply light touching or heavy racking blows according to requirements.

(6) Economical consumption of compressed air or steam.

(7) Elimination of heavy anvil blocks.

Whilst the initial cost of a double acting swage forging hammer is slightly higher than that of a drop stamp, the small cost of foundation and the considerably higher production output than can be obtained on the double acting hammer, outweigh many times the small difference in the initial cost, between these two types of hammers.

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