WORSWICK ENGINEERING LTD

WORSWICK

WORLD LEADERS

IN INGOT CASTING TECHNOLOGY

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WORSWICK

WORSWICK ENGINEERING LTD

Worswick Engineering Ltd is a company with over 40 years of experience in Design and Manufacture of Automated Primary and Secondary, Non-Ferrous Metal Ingot Casting and Stacking Equipment.

Systems featuring our unique – Rotary Ingot Casting Machine with internally water cooled moulds, ingot cooling conveyor and automatic Ingot Stacking Machines can be offered to cover most of the Primary and Secondary Smelter requirements for re-melt ingot production at high capacity outputs. Our casting and stacking systems can include automatic stack weighing and strapping equipment to provide a fully automated production line requiring only 2/3 operators.

There are over 300 “Worswick” Casting Machines and 100 “Worswick” Ingot Stackers of various types installed world-wide and many enquiries and orders are received for specialised machines for the non-ferrous metal industry, such as Billet Stackers, Solder Stick Machines, Anode Casting Machines, Pb Sheet Manufacturing Machines, Pb. Dross Removal Machines and automatic Gravity Die Casting Machines to produce everything from Zn. balls to Aluminium Engine Blocks. The Company can also supply semi or fully automatic Sow/Block Casting Machines.

If you have a metal casting or ingot handling requirement and would like to discuss this, please call and we will be pleased to discuss our equipment with you.

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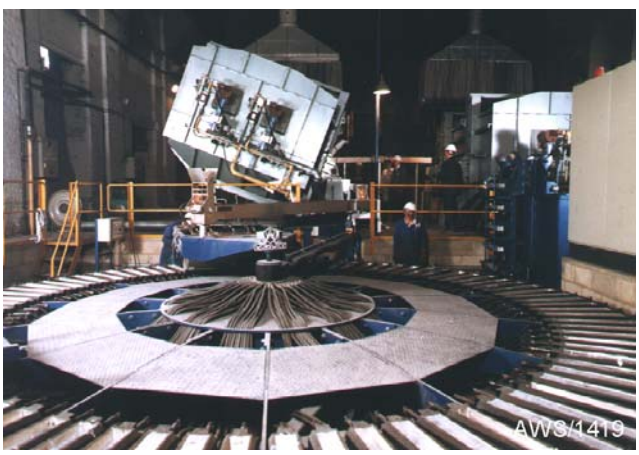
WORLD LEADERS IN INGOT CASTING TECHNOLOGY

ALL CHANGE TO ROTARY

OUR BEST SALESMEN ARE OUR MACHINES

10 t/h Rotary Casting Machine for 7kg. or 5kg. Secondary Aluminium Ingots with Automatic Stacking, Weighing and Semi-Automatic Strapping



There are more than 300 "Worswick" Casting Machines and 100 "Worswick" Stackers World-wide

Al. Sow Casting Machine with Automatic Sow Ejection and Transfer to Storage Conveyor Outputs from 5 to 20 t/h

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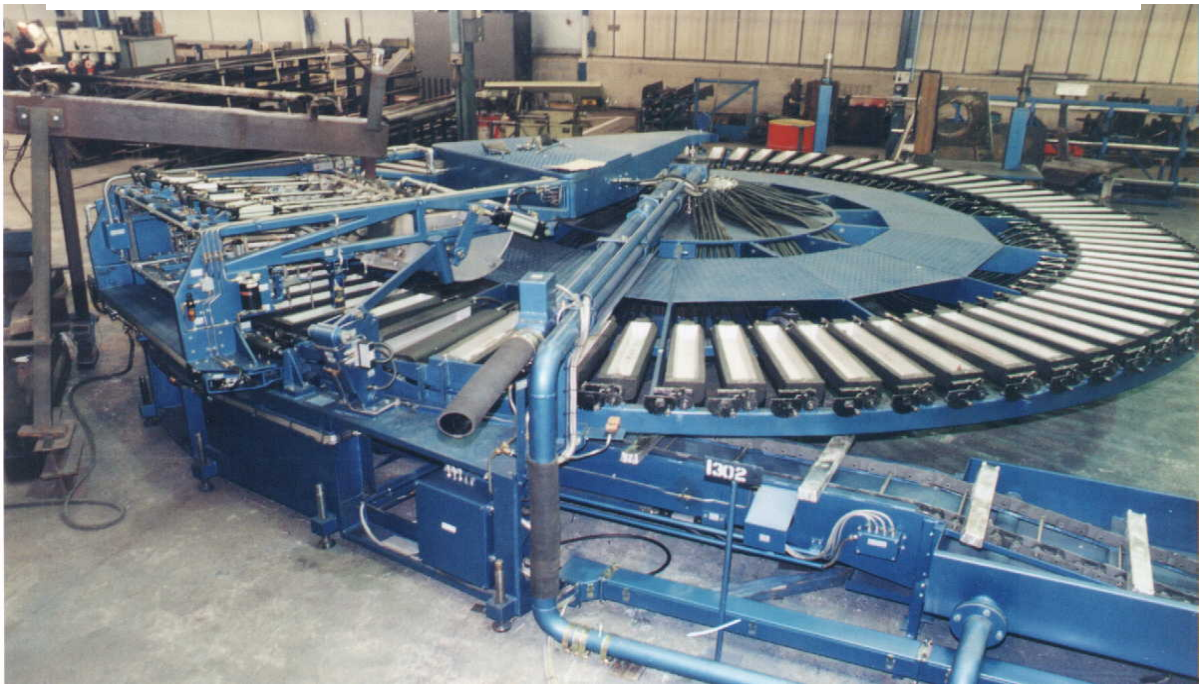
AUTOMATIC INGOT CASTING MACHINE



CASTS Ag - Al - Mg - Pb - Sn - Zn
INGOTS IN PRIMARY METAL & SECONDARY ALLOYS

CAPACITIES: Depending on ingot size, range from:
2 to 25 t/h for Al. and Zn. Ingots
6 to 50 t/h for Pb.
1 to 6 t/h for Mg. & Sn.

INGOTS: From 5 - 25 kg. Al. - Mg. - Zn. and their alloys
25 - 50 kg. Pb. - Ag. - Sn.

"Worswick" rotary ingot casting machines are widely accepted for their efficiency, low maintenance and ease of operation. When metal is supplied from either a tilting furnace or metal pump it is a relatively simple and inexpensive matter for "Worswick" to engineer a completely automatic feed control, thus eliminating constant operator attention.

The variable speed continuously rotating mould table is centrally supported by a heavy duty – low friction bearing ensuring life long smooth vibration free service. Mounted on the table are the internally water cooled moulds, each of which can be quickly and easily levelled in two planes and can be quickly changed when two or more ingot shapes are to be produced. Reversible moulds with two different cavities are also available.

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SOME ADVANTAGES OF THE "WORSWICK" APPROACH TO AUTOMATIC CASTING OF NON-FERROUS INGOTS WITH ROTARY MACHINES AGAINST CONVEYOR TYPE

MOULDS

Internally water cooled using stainless tubing which is cast directly into the good quality heavy section cast iron moulds. Cooling water flows through the moulds at all times, hence they are more dimensionally stable and this gives good ingot ejection characteristics and also tends to impart a good surface finish. Some clients also find that the internal metallurgical structure of alloy ingots is improved by the virtue of the relatively quick chill achieved.

Because the moulds are constantly cooled, there is virtually no transfer of heat to the main structure of the casting machine and a more comfortable environment exists for the machine operator.

The moulds are mounted on the machine in such a way that mould replacement can be carried out over the space of only a few minutes, and entails only the disconnection of the two cooling water hoses and the removal of one screw and a pinion gear from a splined shaft. A special feature is the simplicity and speed in which each mould can be levelled on two axis.

"Worswick" moulds are more efficient with regard to ingot cooling. Also by virtue of the moulds being mounted on a circular table, they are in actual use for approximately 95% of the time. These two factors mean that far fewer moulds are required for a given capacity, when compared to those used on straight line casting machines, which may or may not be externally cooled for part of the casting cycle, and where the mould utilisation rate is only approximately 50%.

Because the mould cooling system is virtually a closed cycle system, no loose water or steam is produced in the casting area. This contrasts directly with the external water spray cooling systems used on other types of casting machines, where the possibility of water in the mould cavities can result in explosions taking place. Apart from the safety factor with "Worswick" equipment, a considerable saving on installation costs is achieved, **as no hooding or vapour extraction system is required,** and this point should be taken into consideration when the casting machine bid evaluations are being compiled.

DRIVE

The smallest machines require a 0.185 kW electric motor and with the medium and large capacity machines, a 0.375 kW electric motor is used both in conjunction with a double reduction worm gearbox and pinion drive engaging with an external gear on the large crossroll type slewring centre bearing. An electronic motor speed controller allows infinite speed variation of the table rotation. These drives ensure that the casting machines have a life-long vibration free operation, which contrasts with straight line or conveyor type machines. As the heavy chains on these machines wear, they do not engage correctly with the sprockets, having the effect of the resultant vibration causing undesirable ripples on the ingot surfaces.

With the rotary machine there is no variation in speed, no movement of the metal in the moulds and no vibration and this is still true with some “Worswick” machines still in use after more than 20 years.

Lubrication of the chains/rollers of a conveyor type machine is also an ongoing problem, not helped by the cycle of heating and cooling and the corrosion caused by the effects of high humidity associated with mould water spray or bath cooling systems.

We will guarantee that our machine produces ingots with a better surface finish than any other machine available, and as an indication of the smoothness of rotation, our standard test is to stand a coin on edge on the rim of the machine and it must stay there whilst the machine is rotating. No chain type machines can even begin to compare with this.

POURING

The well proven "Worswick" system of casting ingots is such that the production of stacks to a very high accuracy can be achieved. The casting speed does not have to be accurately matched to the metal flow from the furnace, as the pouring principle is positive and is not dependent on a time basis, or specific flow rate. Hence, from the very start of the cast, the ingots produced are of a nominal weight and remain so until the cast is completed, and the feed unit drained, only then may the last ingots be undersized, due to lack of metal.

The principle of pouring more than one ingot at a time, yet maintaining individual control, means that a sufficient period of time can be allowed for pouring, to minimise turbulence and the formation of drosses.

MAINTENANCE

"Worswick" casting machines require little maintenance. Wherever possible, dry lubricated bearings are used. The pneumatic valves and cylinders require little maintenance, apart from the occasional replacement of seals etc.

It should be noted that access to all parts of the casting machine is very good.

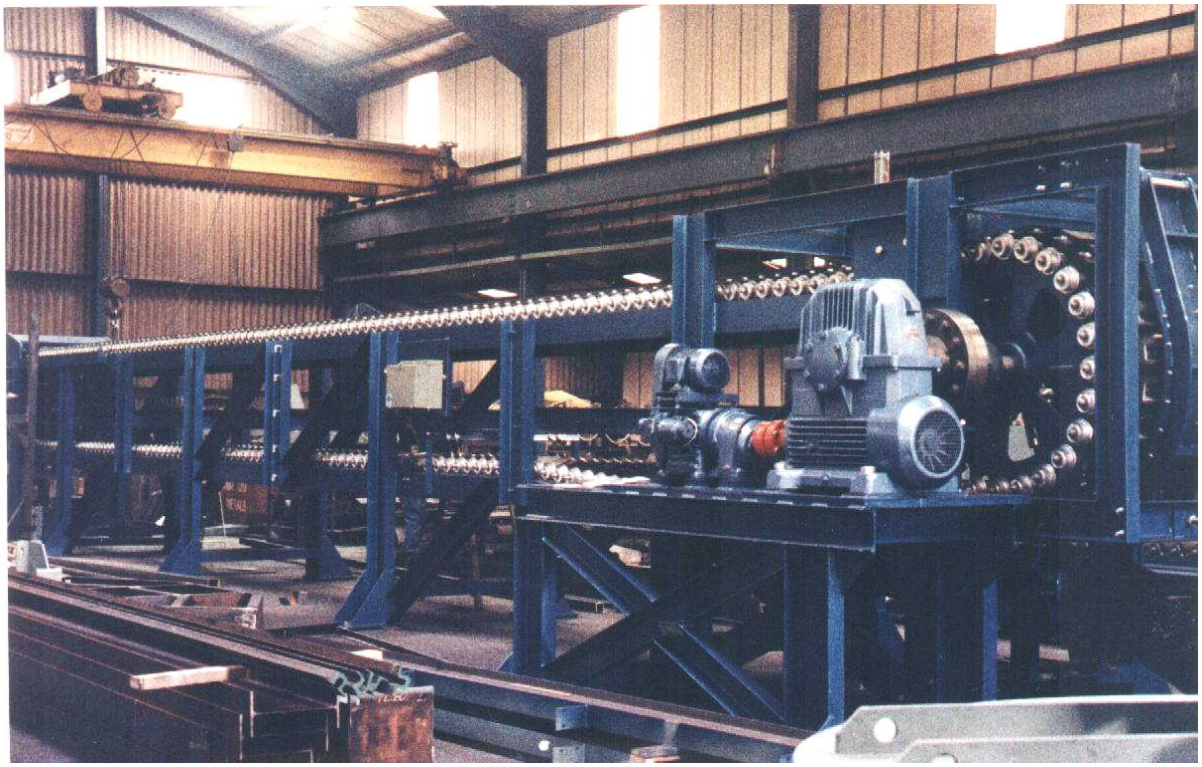
FOUNDATIONS

No specific requirements. The machine rests on jack-screws, which are also used for levelling purposes.

SPACE REQUIREMENTS

"Worswick" casting machines normally occupy far less floor area than straight-line machines, for a given capacity, resulting in lower building costs.

STRAIGHT LINE / CHAIN CONVEYOR INGOT CASTING MACHINE



CAPACITIES: Depending on ingot size, range from:
2 to 25 t/h for Al. and Zn. Ingots
6 to 50 t/h for Pb.
1 to 6 t/h for Mg. & Sn.

INGOTS: From 5 - 25 kg. Al. - Mg. - Zn. and their alloys
25 - 50 kg. Pb. - Ag. - Sn.

Where space requirements dictate a straight line chain conveyor type casting machine or for those customers who prefer the classical approach to ingot casting, Worswick Engineering Ltd produce a range of inline casting machines which include the advanced features evident in the whole range of “Worswick” equipment which have resulted from over 40 years of experience within the foundry equipment environment. The machines are manufactured with a very robust frame and drive mechanism and with sealed wheels on high quality matched length chains the machines are well equipped for the rugged casting environment.

The “Worswick” proven system of pouring a number of moulds simultaneously with accurate control of the volume of metal poured into each mould ensures minimum dross formation and consistent ingots.

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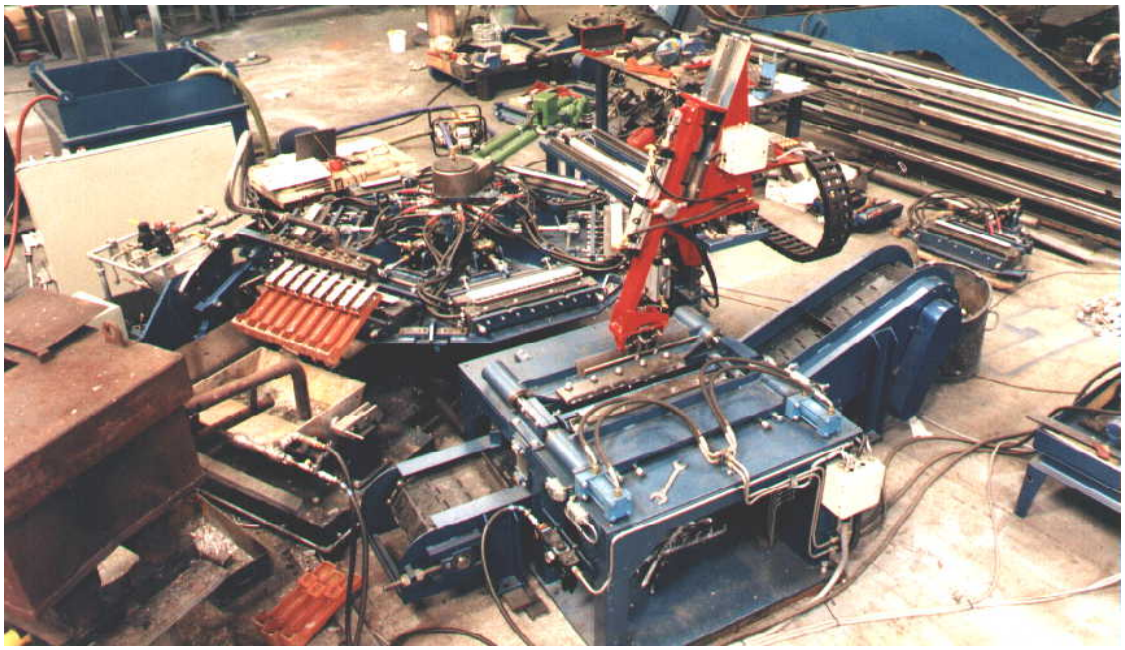
AUTOMATIC – Zn. & Cd. BALL / STICK CASTING MACHINE

500g. Zn. / Cd. Balls – nominally 50mm Ø
250-1000g Cd. Sticks



AWS/1856

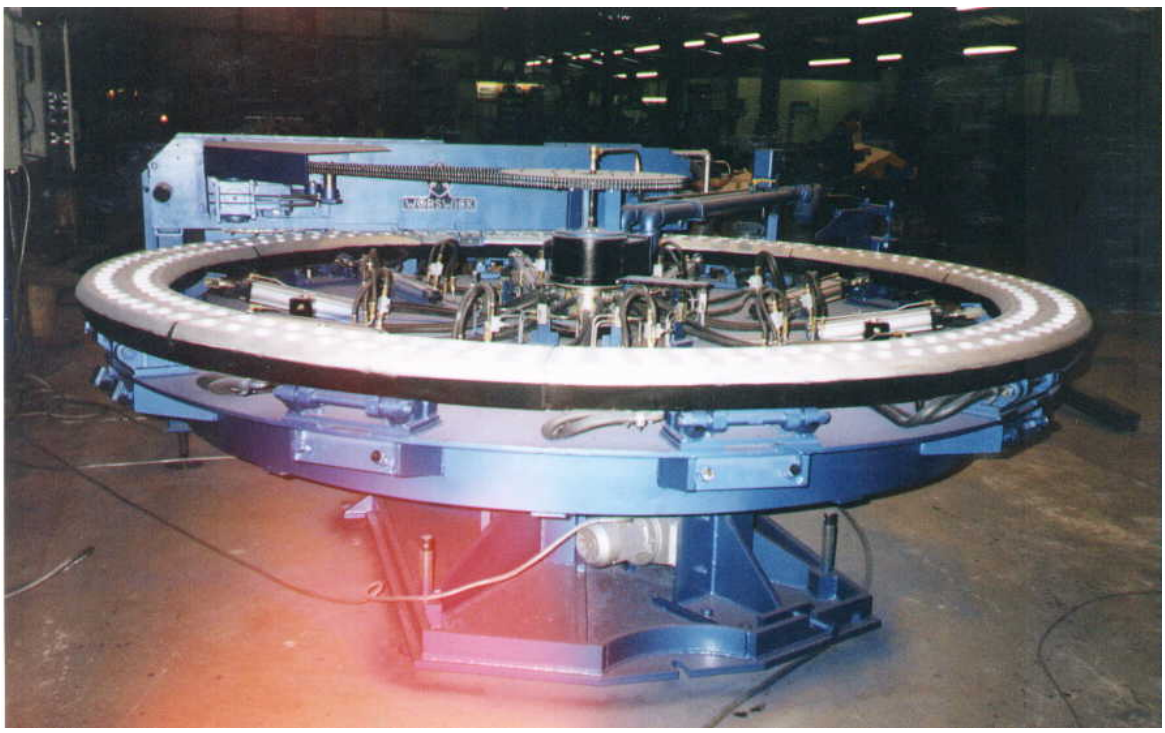
Continuous production of up to 1500 kg/hr of Zn. balls or Cd. balls/sticks having consistent weight is available by means of the proven "Worswick" rotary casting concept with internally water-cooled moulds.

The machine comprises a rotating/indexing mould table having either 6 ball or 6 stick moulds arranged tangentially around it. The multi-cavity – 'split' moulds complete with operating mechanism can be quickly changed to suit the type of product required. Alternatively a 12 station machine with both alternate ball and stick moulds mounted on it can be supplied, which can produce either balls or sticks automatically by operator selection from the control panel. In this form, the machine would index two mould positions after each pour, to maintain the same product type production. The molten metal feed unit comprises a metal holding bath and a volumetric pouring ladle, which will automatically deliver the correct amount of metal to each mould cavity. The unit is complete with gas/air fired metal bath and feed ladle preheating burners and 'fail-safe' gas/air train control systems. The casting machine operates fully automatically and is complete with integral electrical control console containing all automatic controls and the PLC, together with necessary operator controls for automatic and manual operations.

A sprue/runner shear unit is included to operate as an integral part of the complete ball/stick casting machine and is interlocked to ensure correct operation. This comprises a transfer mechanism to pick up the balls/sticks (attached to the sprue/runner) from the moulds and transfer them to a separate – adjacent, hydraulically powered shearing unit. Balls/sticks are ejected onto an in-built removal conveyor, whilst the sprues are diverted into a container at the side of the shear unit. The shear unit is complete with its own separate hydraulic power pack and controls necessary for operation.

Also available as an optional extra is a powered slat type, indexing removal conveyor which will be interfaced with the sprue shear device, onto which are pre-loaded clients boxes/containers to receive the sheared balls/sticks or alternatively they can drop straight onto the conveyor to deliver to a boxing/bagging station at the conveyor end.

AUTOMATIC – ROTARY DE-OX NUGGET CASTING MACHINE



CAPACITY: 2000 – 3000 kg/h – dependent on nugget weight.

NUGGET SIZE: 50 to 250g – controllable by metal flow rate & table rotational speed.

SHAPES: trunkated cones & pyramids – hemispherical ended cones – half rounds and others.

Continuous production of high quality de-ox aluminium nuggets – 'flash/tail free' – having consistent weight, by means of the proven "Worswick" rotary casting concept with internally water-cooled moulds.

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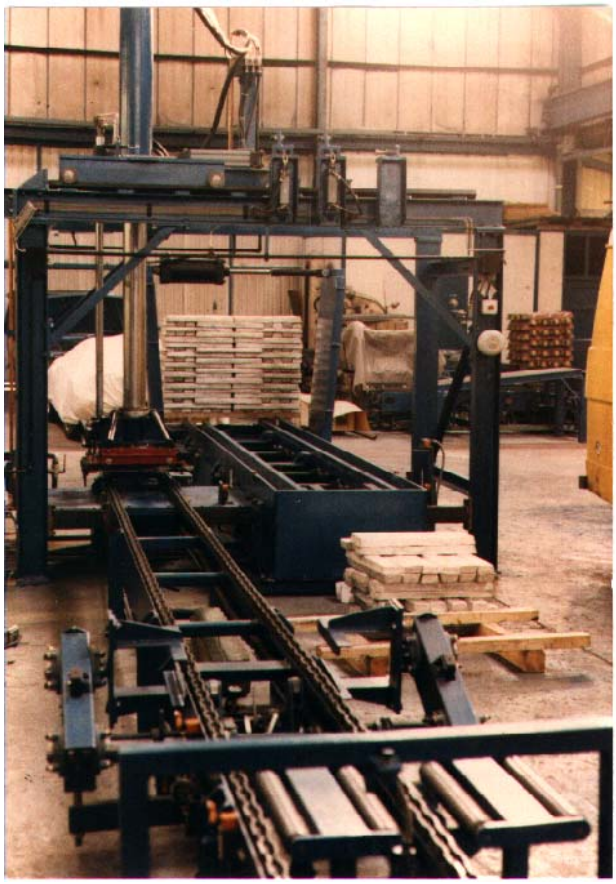
OVERHEAD GANTRY TYPE INGOT STACKING MACHINE



AWS/870

This model in the “Worswick” range of Ingot Stacking Equipment is perhaps the most versatile and fully automated stacking unit yet produced.

The stacking machine is suitable to receive ingots from either an inline or rotary casting machine and can be ‘customised’ to suit each individual application. It can be arranged in various different configurations from inline to right angle systems.

It is PLC controlled and compressed air powered.

The stacking machine consists of 3-separate elements:

(i) a chain type ingot receiving & accumulation conveyor having a selective ingot turnover device and if required, an ‘over/undersize’ ingot rejection mechanism.

(ii) an overhead gantry type - automatic stacking unit comprising a carriage mounted stacking grab.

(iii) a 6-position stack storage conveyor of either a twin chain, chain & slat or chain & stillage type, according to stack type.

The machine will build ‘single’ square stacks of nested - cross-layered ingots, on either pre-cast or wooden pallet bases, or regular foot ingots. It will also build 2 of these stacks side by side on a common base, to form a ‘double stack’.

Alternatively, the Stacker can be programmed to build ‘bonded’ type double stacks as shown on the accompanying photograph.

The stacking equipment has an output capacity of up to 1800 ingots/hour.

Ingots can be stacked hot on wooden, steel or pre-cast pallet bases for removal from the stacking machine so that they may be allowed to cool before strapping. Alternatively, they can be cooled prior to stacking by a “Worswick” cooling conveyor.

Automatic weighing equipment and, where the ingots can be pre-cooled to strapping temperature, semi automatic strapping and shrink wrapping equipment are also available for fitment to the stack storage conveyor at extra cost.

AUTOMATIC LIFT TABLE
INGOT STACKING MACHINE
FOR ‘EARED’ INGOTS

15-50kg ‘EARED’ – INGOTS/PIGS IN 1.0–2.0t STACKS

Developed due to customer enthusiasm for the operating principle of our original Lift Table Stacker, this version is suitable for stacking ‘eared’ ingots/pigs into either nested or non-nested, cross-layered, traditional stack formations, having a full base layer.

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LIFT TABLE – INGOT STACKING EQUIPMENT

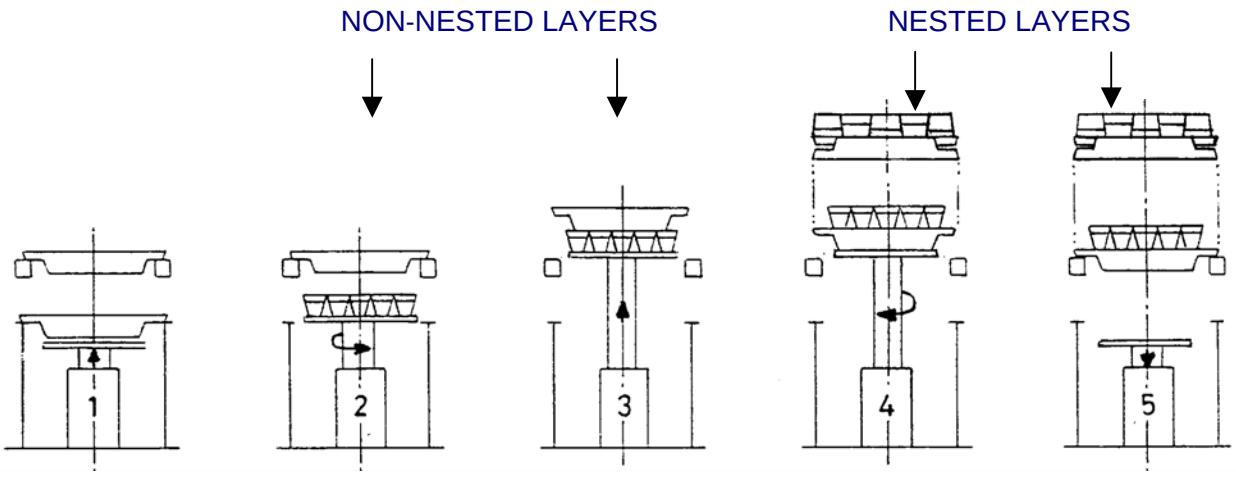
This consists of 3-conveyors: the first conveyor being the ingot receiving conveyor with ingot turnover device and incorporating the Lift Table Stacking unit. The second conveyor is a stack transfer conveyor of the walking beam type to remove the stacks from the stacking unit frame and transfer them to the stack storage conveyor. This conveyor has 2 stack positions as standard, with additional positions added as required to accommodate optional ancillary equipment. The third conveyor is the stack storage conveyor and is a power driven roller conveyor which will hold up to 6 completed stacks *(longer versions are available).*

Equipment layouts with the stack transfer conveyor running to the left or right at 90º to the stacking unit, or in line with it are possible, but the stack storage conveyor must always run at 90º to the left or right of the transfer conveyor to ensure that the stack base layer of ingots run in line with it on the powered rollers.

ADDITIONAL EQUIPMENT

Automatic stack weighing and semi or fully automatic stack strapping – located on the walking beam stack transfer conveyor are available as optional features.

UNIQUE	-	IT STACKS THE TOP LAYER FIRST – THE BASE LAYER LAST
FAST	-	UP TO 2000 INGOTS PER HOUR
SIMPLE	-	ONLY 7 CONTROL VALVES
RELIABLE	-	HYDRAULIC OPERATION – PLC CONTROLLED
SAFE & QUIET	-	NO INGOTS TRAVELLING OVERHEAD
ANCILLARIES	-	STRAPPING AND WEIGHING EASILY FITTED
POWER	-	INSTALLED LOAD 12 Kw



← LAYER OF INGOTS ACCUMULATES OVER LIFT TABLE

↑ TABLE LIFTS 50mm AND ROTATES 90º

→ TABLE LIFTS INGOT LAYER THROUGH STACKING FRAME AND LIFTS PREVIOUS LAYERS

↓ TABLE ROTATES 90º

° LOWERS FULLY LEAVING STACK ON FRAME

WITH OUR **'ROTARY & CONVEYOR INGOT CASTING MACHINES'** WE OFFER THE MOST ADVANCED EQUIPMENT FOR NON-FERROUS INGOT PRODUCTION

AUTOMATIC LIFT TABLE INGOT STACKING MACHINE

The "Worswick" Lift Table Stacking Machine is designed to handle 5-15kg. Al.-Zn.-Mg. ingots at stacking speeds much higher than is possible with the Radial Arm type stacker. Stacking speeds of up to 2200 ingots/hour are possible, dependent on the number of ingots/layer required.

The standard design is suitable for building stacks of regular shaped ingots whose accumulated layer width is less than the overall length of the ingots.

STANDARD DUTY MACHINE

This consists of essentially 2-conveyors at 90º to each other; the first conveyor being an ingot receiving conveyor with the selective ingot turnover unit and incorporating at its junction end with the second conveyor the lift table stacking unit. The second conveyor is the stack storage conveyor and is of the walking beam type, this will remove the completed stacks from the stacking unit frame and store up to 5 completed stacks *(longer versions are available).*

NOTE: Left or right hand layouts are offered as well as a layout with both conveyors in line with each other.

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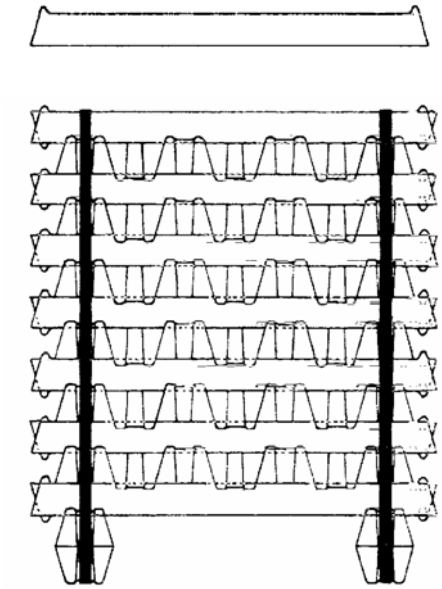
ADDITIONAL EQUIPMENT

Automatic stack weighing and semi or fully automatic stack strapping are available as optional features.

NOTE: If the stacks are to be strapped immediately after they are built, the ingots will require cooling prior to the stack being built. For this purpose, an ingot cooling conveyor of either horizontal or vertical type will be a necessary requirement of the layout, located immediately before the stacking machine.



UNIQUE - IT STACKS THE TOP LAYER FIRST – THE FOOT INGOTS LAST

FAST - UP TO 2200 INGOTS PER HOUR

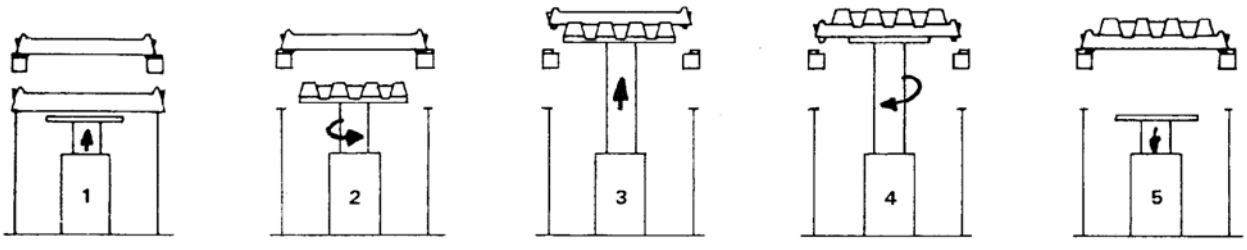
SIMPLE - ONLY 7 CONTROL VALVES

RELIABLE - HYDRAULIC OPERATION – MICRO-PROCESSOR CONTROL

SAFE & QUIET - NO INGOTS TRAVELLING OVERHEAD

ANCILLARIES - STRAPPING AND WEIGHING EASILY FITTED

POWER - INSTALLED LOAD 10kW



← LAYER OF INGOT ACCUMULATES OVER LIFT TABLE

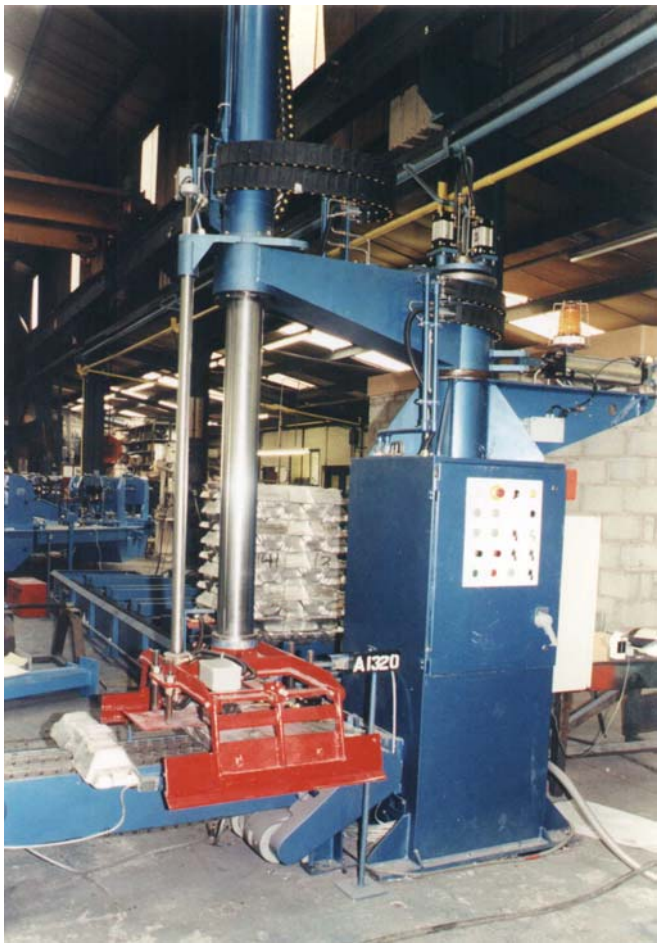
↑ TABLE LIFTS 50mm AND ROTATES 90º

→ TABLE LIFTS INGOT LAYER THROUGH STACKING FRAME AND LIFTS PREVIOUS LAYERS.

↓ TABLE ROTATES 90º

° LOWERS FULLY LEAVING STACK ON FRAME

AUTOMATIC RADIAL ARM INGOT STACKING MACHINE



WHAT CAN IT DO?

1. Handle ingots between 450mm and 840mm long. Regular, eared, inter-locking or 'T' shaped.

2. Form layers with all ingots the same way or with alternate ingots turned over, or with a combination of these arrangements.

3. Will turn alternate ingots end for end to achieve ingot inter-locking when this is required.

4. For forklift truck handling, will position pairs of foot ingots or leave voids in the stack.

5. Build stacks with alternate layers at 90º, or with all layers having ingots running parallel or a combination of these two.

6. Strap stacks using semi or fully automatic integrated equipment. *(supplied as an optional extra)*

7. Automatically weigh each stack using integrated equipment. *(supplied as an optional extra)*

8. Be arranged to fit in with most existing plant layouts.

9. Handle in excess of 1,000 ingots/hour, depending on the number of ingots per layer and stack pattern required.

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HOW IS IT DONE?

By means of a programmable logic controller (PLC) which is programmed to suit your ingot stack pattern. The PLC unit controls all functions of the stacker as it builds the stack and can be pre-programmed to build stacks with varying numbers of layers, selected by a switch on the control panel.

Each ingot delivered from the casting machine is automatically spaced on the ingot receiving conveyor, so that they may be fed one at a time past the ingot counting lever to a position where, if instructed by the PLC on receiving the counting signal, the ingot will be turned over. The ingots then continue along to the accumulator section where the layer is formed and then picked up automatically by the grab jaws and the radial arm is swung through 90º to the stacking position. During this part of the stacking sequence, the grab jaw assembly itself may also rotate through 90º if the PLC program signals this, in order to place the layer at 90º to the preceding layer thus forming a cross-layered stack.

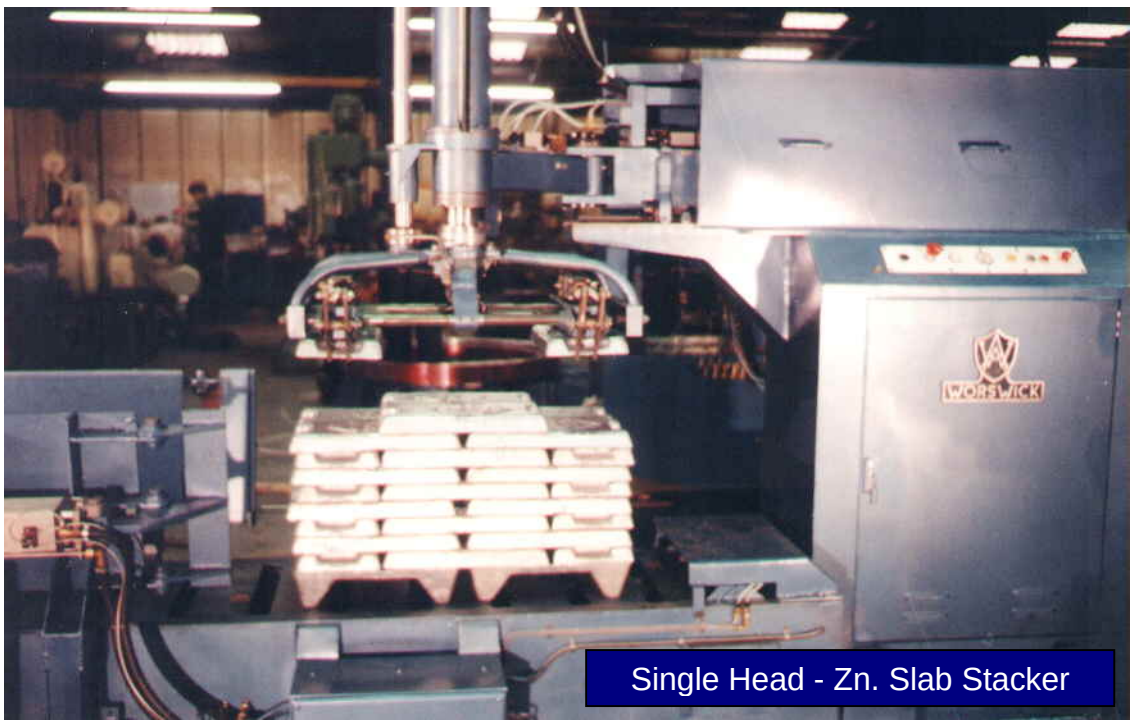
The basic component parts of the system consist of an electrically driven chain type ingot receiving conveyor to receive the ingots directly from the casting machine or via a cooling conveyor, the radial arm stacking unit and a stack storage conveyor on which the stacks are built. The stack storage conveyor is an electrically driven chain type, normally equipped with cross stillages. The standard unit accommodates 5 completed stacks, but a larger unit can be supplied to hold 9 stacks. Semi or fully automatic stack strapping and automatic stack weighing are available as optional features. If the stack is built on foot ingots and automatic weighing is required, a walking beam type stack storage conveyor is preferred, as this simplifies the incorporation of the weighing equipment.

If the stacks are to be strapped immediately after they are built the ingots will require further cooling prior to the stack being built. For this purpose, an ingot cooling conveyor of either horizontal or vertical type will be a necessary requirement of the layout, located immediately before the stacking machine.

The standard stacking unit is PLC controlled and is powered by compressed air at a constant supply pressure of 6 bar (90psi). The speed of operation is basically governed by the rate at which ingots are received from the casting machine or cooling conveyor.

The various components of the "Worswick" Radial Arm Stacker can be arranged in a considerable variety of ways to make maximum use of the space available and can be connected to customer’s existing conveyor type casting machines as well as the "Worswick" Rotary Ingot Casting Machine.

Zn. SLAB STACKING MACHINE



Single Head - Zn. Slab Stacker

Twin Head – Zn. Slab Stacker

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"WORSWICK" Zn. SLAB STACKING MACHINE

To compliment the "Worswick" range of stacking machines for ‘regular shaped’ ingots, we have developed specialised stackers dedicated to handling ‘primary Zn. slab ingots’ which, together with our rotary casting machines, enables a fully automated production facility to be offered.

2-models of Zn. slab stacker are available; a ‘single head’ version, as shown on the front side of this leaflet, suitable for production rates of up to 500 slabs/hour – equivalent to 12.5 t/h of 25kg. slabs and a ‘twin head’ version, also shown on front side of this leaflet, suitable for production rates of up to 1,000 slabs/hour – equivalent to 25 t/h of 25kg. slabs.

Both stackers are designed to operate with our own rotary ingot casting machine, or alternatively can be installed (together with suitable custom designed interface equipment) to receive slabs from customers existing casting machines, casting conveyors and with or without our ingot/slab cooling conveyors.

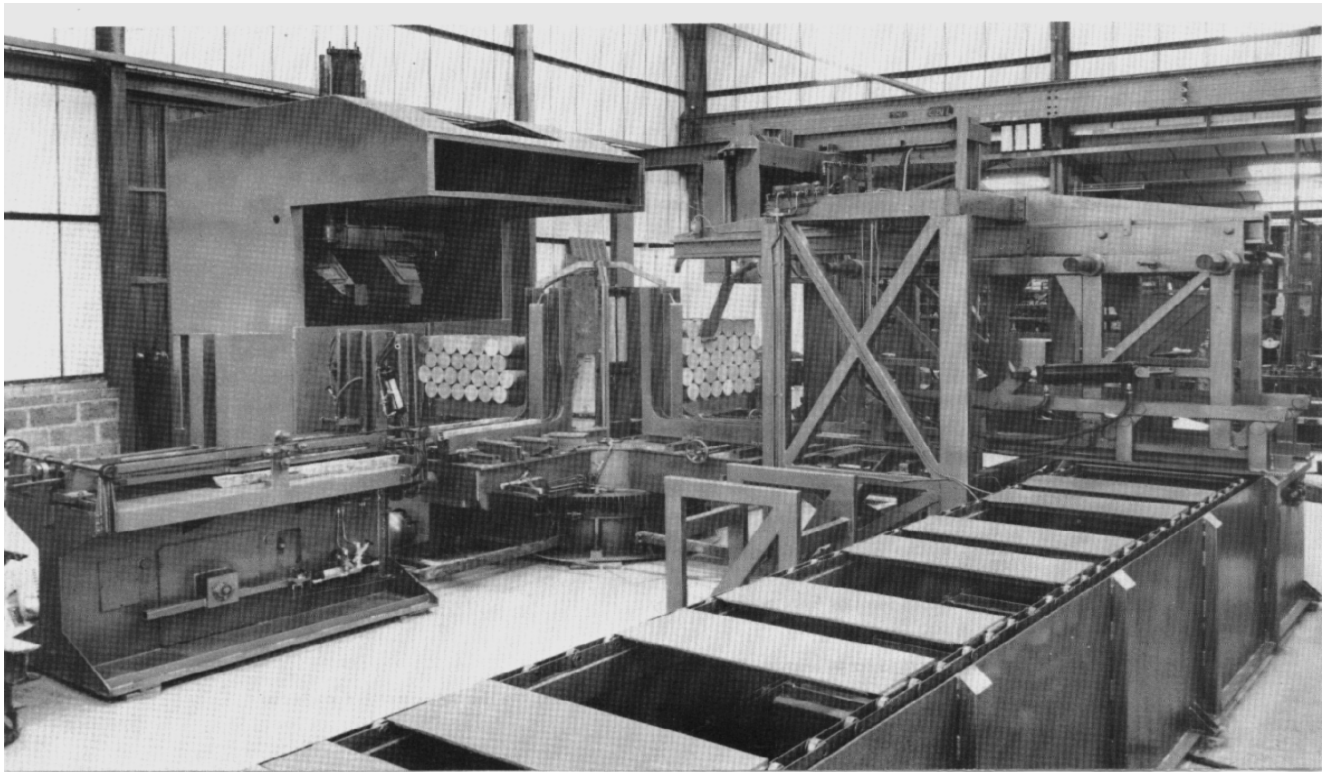
Each model will handle traditionally shaped slabs and pedestal ‘foot ingots’ and is controlled by a PLC unit which can be pre-programmed to build either ‘all slab’ or combination slab/pedestal ‘foot ingot’ stacks. Any or all of the slabs can be automatically inverted to form monogram face up, or monogram face down layers.

Each model of Zn. slab stacker will consist of an ingot receiving conveyor fitted with a slab straightening/centering device and where appropriate – a slab turnover device; a pneumatically powered slab stacking unit and a stack storage conveyor to store up to 5 completed stacks (longer versions are available).

ADDITIONAL – OPTIONAL EQUIPMENT

- Vertical or horizontal cooling conveyors to reduce the ingot/slab temperatures so that strapping can be applied immediately after the stacks are built.
- Proprietary make, automatic stack weighing and ticket/label printing equipment.
- Proprietary make, semi or fully automatic strapping equipment.
- Stack compression device to consolidate slabs coming from existing inline casting machines if these are not of consistent size. This equipment is not necessary with "Worswick" casting machines which produce stacks which are guaranteed to be within ± 2% of the desired weight.

BAR & BILLET STACKING MACHINE



The machine shown on this page was developed specifically to stack, strap and weigh a wide variety of stack configurations covering a considerable portion of the extrusion billet sizes commonly in use today. Therefore, billet diameters ranging from 140mm to 380mm ∅ can be handled in lengths varying from 350mm to 915mm.

The cut billets are received automatically and counted and assembled into layers according to the information programmed into the programmable logic controller (PLC). The bundle is built on a central, indexing, four-position table, onto two wooden or metal skids, which have been automatically positioned beforehand. The table carrying the bundle is then indexed through 90° whilst the bundle is in a powerful clamp. Two heavy-duty straps are then automatically fed around the bundle and sealed. In the meantime another bundle is being built at the first position on the stacking table. The strapped bundle would then be again indexed through 90° to the removal and weighing position, making way for the newly completed bundle. Here the bundle would be removed with the use of a walking beam assembly and automatically placed on a weighing unit for weighing purposes. During the next machine cycle the weighed bundle would be removed from the weighing station and placed on a storage conveyor which would then index the bundle away to make room for the next strapped and weighed bundle. Bundles would then be removed from the storage conveyor by either overhead crane or forklift truck.

To change from one billet size and bundle configuration to another entails the need only to switch from one stack program to another using the program selector switch on the control panel, and manually resetting certain stops and guides, these operations taking approximately 10 minutes

Alternatively, at extra cost, these stops and guides can be powered and by means of extra PLC program, automatically re-positioned according to the billet size/bundle configuration selected from the program selector switch.

Overall control of the equipment is by PLC and the indexing stacking table and storage conveyor are electric motor driven. The stacking machine is powered by compressed air at normally available supply pressures.

***NOTE**: Square or rectangular sawn billets can be handled by this or other stackers in the "Worswick" range.*

WORLD LEADERS IN INGOT CASTING TECHNOLOGY

CASTING, COOLING, STACKING, WEIGHING, STRAPPING

ROTARY OR STRAIGHT LINE

THE ULTIMATE IN AUTOMATION

The straight-line machine shown below is for 20TPH of 30lb. (13.4kg) Al. ingots with automatic feed, ingot cooling, stacking, weighing, strapping and shrink wrapping.

JUMBO BLOCK CASTING, STACKING AND WEIGHING UP TO 20TPH

*** VIDEOS AVAILABLE ***

AUTOMATED PRODUCTION OF SOWS. Zn. Al. Pb. Mg. – Zn. Cd. BALL & STICK – Al. NUGGETS – ANODE CASTING MACHINES – SOLDER STICK CASTING MACHINES

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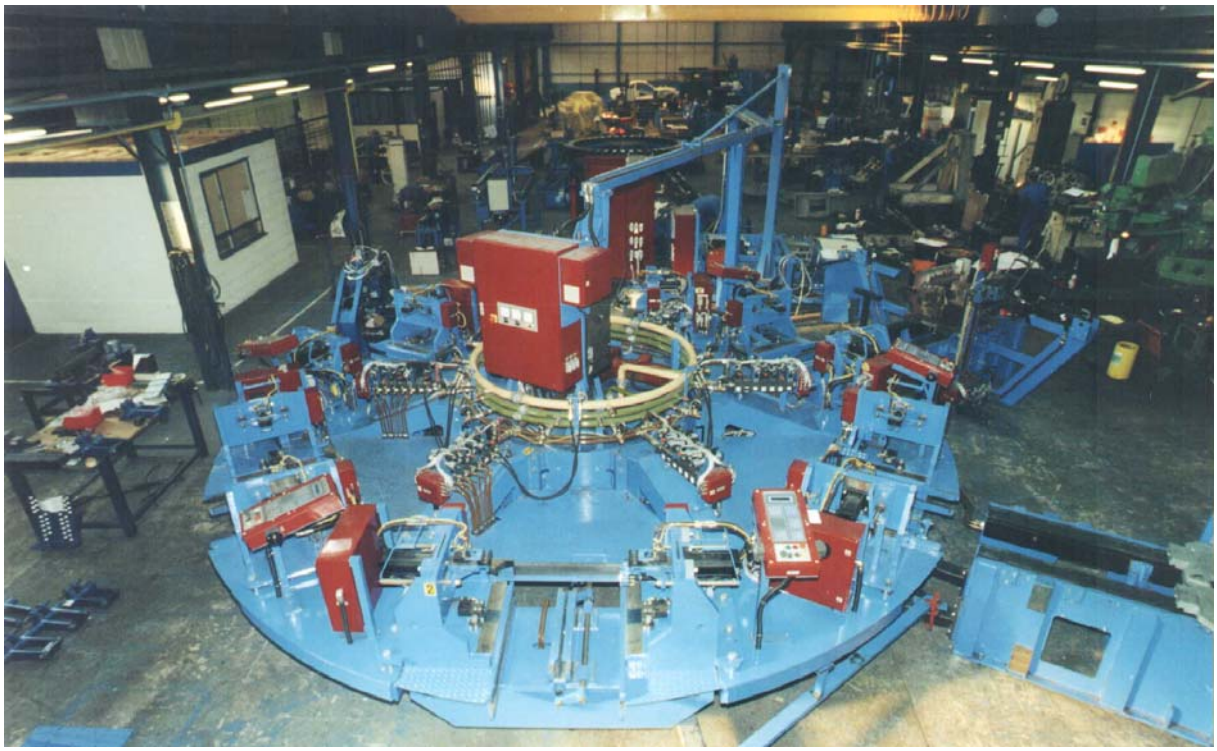
MULTI STATION
DIE CASTING MACHINE



6 Station Cylinder Head Casting Machine during construction

The turntable machine can consist of up to 8 stations, each station of which can be fitted with its own PLC which is responsible for the complete control of that particular die. The advantage of this feature is that the die does not have to wait until it comes round to a master station to be manipulated. Each die has its own individual control and cooling time memory such that, as and when each individual cooling cycle has finished, the die will split and open at the optimum time enabling the casting to be ejected in a much more controlled and reliable way. A further advantage of having individual control of the die by fitting a cylinder for every single axis of movement of the die, is that each die can be switched to manual control and each operating cylinder can be cycled individually as required by the operator. During normal operation all die movements are automatically computer controlled and cycled, requiring only confirmation by the operator that the die is clean and fitted with a core package to allow the machine to index to the next position.

The core packages can be loaded automatically, the loading robot giving the machine a signal to confirm that core loading is complete and that the robot is clear of the die. When the newly cored up die is moved into position underneath the pouring robot the necessary interlock signal will be passed to instruct the robot to collect metal in order to pour a new casting. In this case the die can be recognised by a six channel BCD

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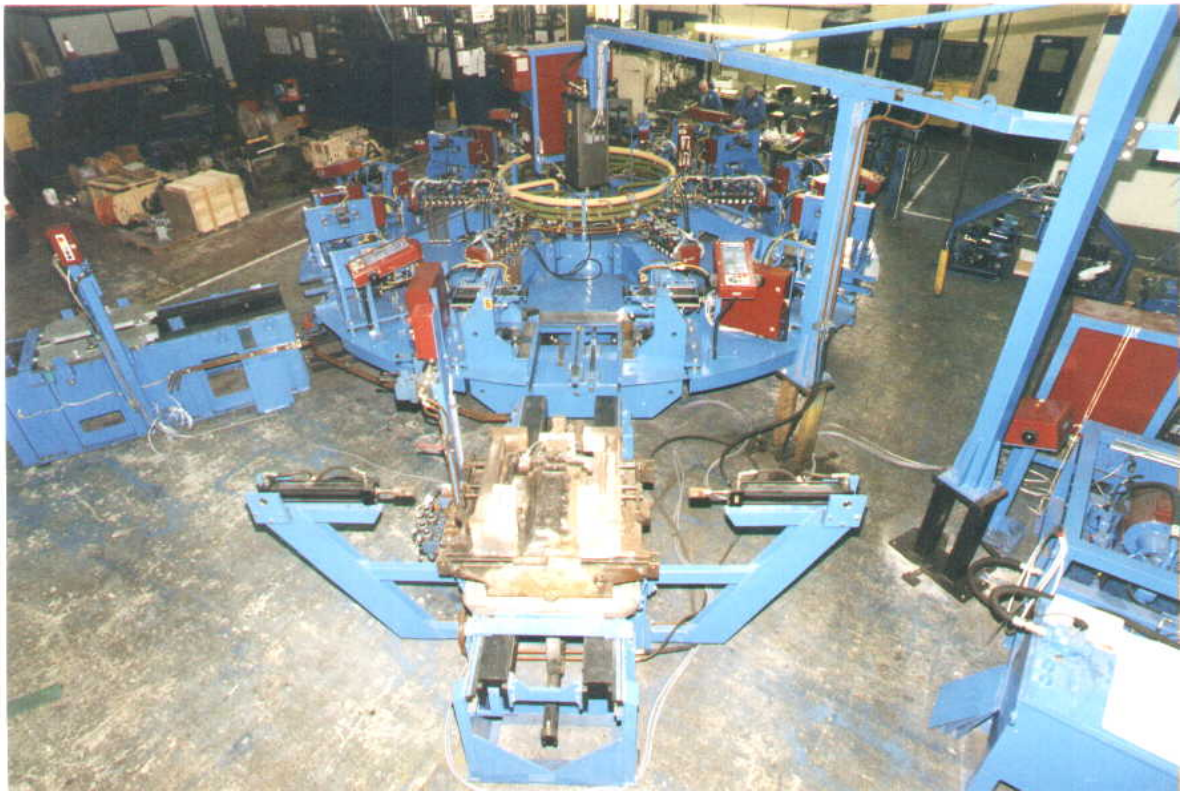
arranged sensor which can, if necessary, indicate to the pouring robot different pouring cycles or charge weights, such that the robot could automatically calibrate itself for a change of dies fitted to the machine. At the same time that the pouring cycle takes place at the pour point, the following positions cool and their individual cooling time is timed out to allow controlled ejection and at the final position, the computer controlled 'X-Y' gantry for the casting removal is interfaced with the casting machine to remove the newly produced casting and place it onto a casting removal conveyor. The casting extraction gantries can either place the casting on the casting removal conveyor in the same orientation as it was extracted from the die or turn it through 90º as required. The castings can also be tilted through 90º at the inspection station of the gantry so that the lower face of the casting can be visually examined. When all stations have indicated that they are in a safe position and ready for indexing, the table will move one position and the whole cycle starts again.

The machines can also be fitted with two walking beam type conveyors which will load or unload dies to allow hot die changing facilities such that a pre-prepared, coated and pre-warmed die can be fitted to the machine within one index to replace one on which the die coating has been damaged or worn out, thereby substantially reducing down time during the production process.

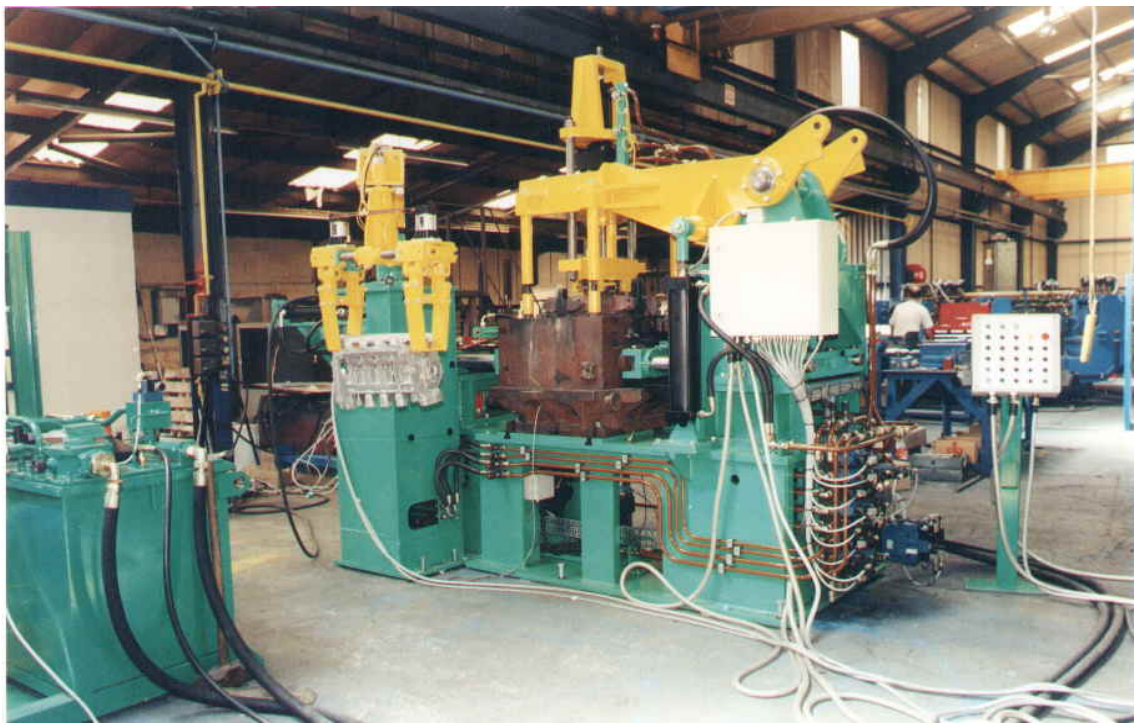
On machines which produce components which are twinned together, the casting removal gantry can place the casting directly into a cropping machine which will automatically remove the feeder bar and thereafter the casting is placed onto the removal conveyor for further operations.

Information from any die blocks and 'X-Y' gantry can be called up on a hardened touch screen 486 computer terminal fitted into the operator station such that he can interrogate any of the inputs and outputs on any of the dies whilst the machine is tuning and also look at the parameters set for the 'X-Y' gantry and the actual position of the gantry at any point. This has the advantage that several menus of gantry positions can be stored, and a change in component production can be set by simply changing the menu to the pre-calibrated values already stored in the computer. Up to four pre-set gantry pick-up points can be stored with the possibility of re-programming any of them for a new product. Also the screen will indicate any alarms that are triggered during the operation of the machine and maintain a history of them for later interrogation or for uploading to a supervisory computer system.



View of a quick die change facility

SINGLE STATION
GRAVITY DIE CASTING MACHINE



Single Station Machine with Top Core Assembly
& Casting Removal Device

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CONSTRUCTION & OPERATION

The base of the machine consists of a substantial steel plate mounted on a support structure so that the top of the plate is approximately .75 metres above ground level. The top of this plate is machined and has two traverse T slots, two traverse keyways, each offset from the centre line of the die by an equal amount and two location keyways running the length of the machine, one on either side of the die centre point. At each end of this base plate is a die side operating mechanism, consisting of a large hydraulic cylinder and two guide bars, all fastened to a die attachment plate, which have the facility for two horseshoe clamps to attach this plate to the die sides when required. An identical assembly is positioned on the other end of the die base in order to operate the other die side. On one end of the die assembly is mounted a top core lifting assembly, which consists of a large arm, mounted on a substantial horizontal pivot shaft, and which operates through approximately 110º by means of hydraulic cylinders mounted on the opposite end of the arm to the top core assembly.

The top core assembly is mounted onto an auxilliary bracket on the end of the tilt arm, which has the facility to be lifted or lowered by approximately 200mm in order to pull the core and also to allow it to be lowered in a truly vertical axis, rather than the radial motion produced by the tilt arm lowering. The tilt arm is fitted with four push out studs, which locate on suitable positions on customers existing die, and is used to assist the extraction of the top core assembly and to stop the hydraulic force of the top core assembly lift cylinder transferring their force to the tilt arm.

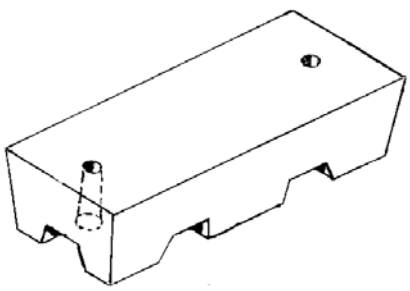
On the opposite end of the die base to the top core lifting assembly is a casting pick out unit, which consists of a radial arm mounted on a large pivot shaft, on which is can also be raised and lowered. At the opposite end of the pick out unit is a set of pneumatically operated jaws, which have removable bolt on arms and are manufactured to suit the casting to be made. In addition one 'flip' cylinder is supplied, for rotating a small piece on the side of the main die assembly and facilities are supplied for the connection of a second cylinder on the opposite end of the main die assembly.

A large cylinder under the die bed is supplied for ejection of the casting. A second angled cylinder under the die bed for attachment to the core pin plate of the die is also supplied.

The machine is supplied complete with all cylinders, hydraulic valves and hydraulic power pack of a suitable capacity and is supplied with a control system.

Zn. GALVANISING SOW/JUMBO CASTING MACHINE

20 t/h *FULLY* automatic jumbo casting machine for 1000kg galvanising jumbos with automatic transfer to storage conveyor



WORSWICK UNIQUE FEATURES

- EJECTION is automatic with transfer to storage conveyor
- NO lifting hooks to place and knock out
- AUTOMATIC forming of lifting holes
- NO taper pins to place in the moulds and force out of the solidified jumbos
- Jumbos of accurate weight
- Smooth vibration free operation
- Hot-Tops for cavity & crack free surface
- Outputs up to 30t/h of 1000kg jumbos or 2000kg jumbos if preferred

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SOW/JUMBO CASTING MACHINE
Al. – Mg. – Pb. – Zn.

Al. - 250 - 1000kg Sows ..... 10 – 20 t/h

Mg. - 100 - 250kg Blocks..... 1 – 5 t/h

Pb. - 1000 - 2000kg Blocks..... 10 – 35 t/h

Zn. - 1000 - 2000kg Jumbo's..... 10 – 25 t/h

The "Worswick" – rotary type – sow/jumbo casting machine retains the same basic design principles as our proven ingot casting machine, to give smooth – vibration free – operation.

Casting Machines can be supplied for either 'batch or continuous' production with mould table diameters varying between 4.5 and 8.5 metres.

** VIDEO AVAILABLE **

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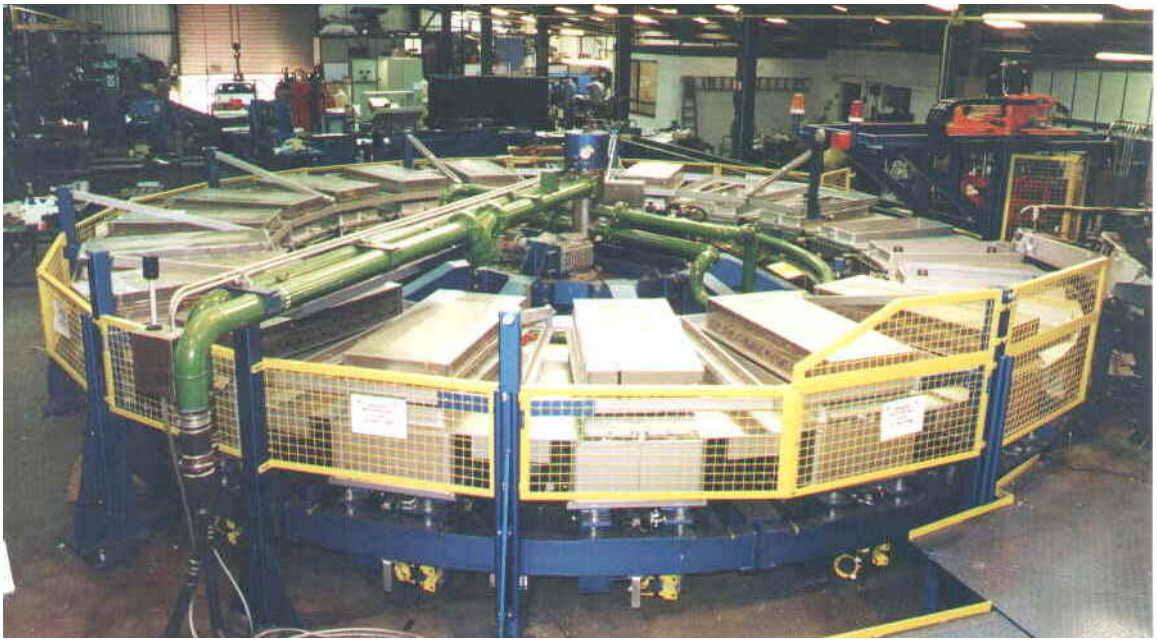

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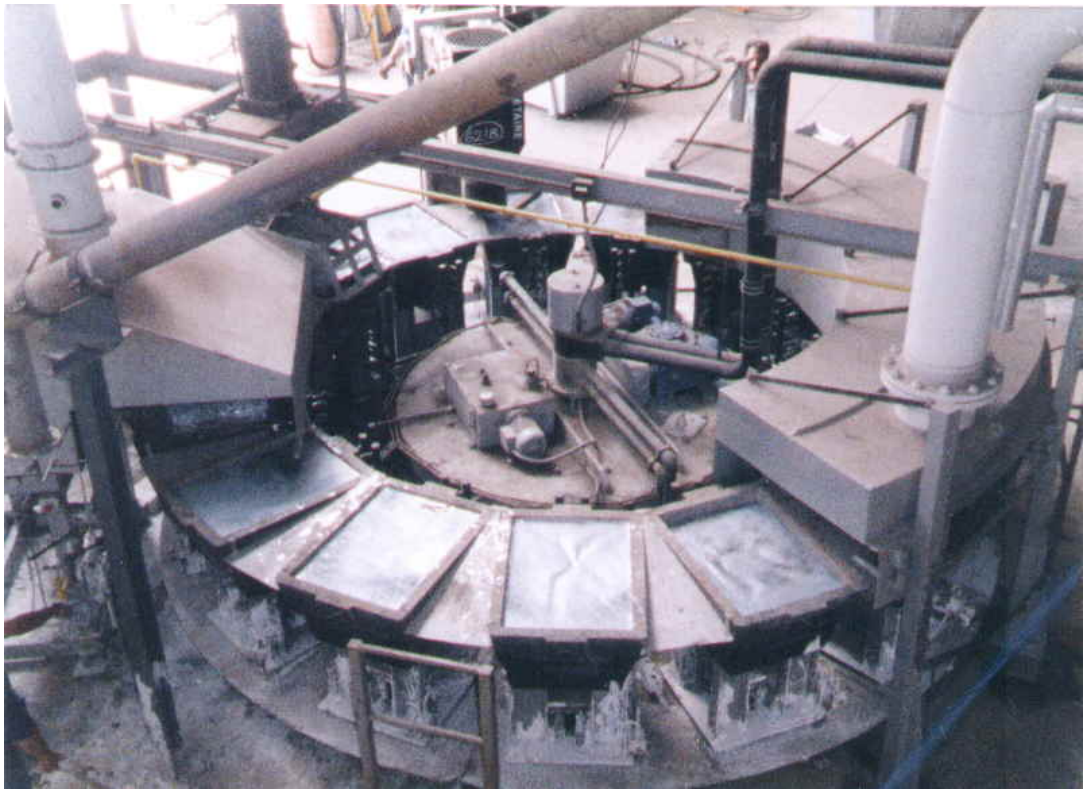

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FEATURES OF SOW CASTING EQUIPMENT

FULLY AUTOMATIC continuous production – from delivery of molten metal from the furnace to removal of solidified sow by fork truck or crane from the storage conveyor.

The fully automated system comprises: the mould table complete with a set of water cooled moulds each fitted with hydraulically powered sow ejector pins, an automatic metal feed unit, a sow/jumbo removal and transfer unit a sow storage conveyor having a capacity of 7 sows with longer versions available.

Alternatively:

SEMI-AUTOMATIC: Production from a less expensive system which requires operator control and removal of the sows from the moulds utilising 'cast-in' hooks, by means of an overhead lifting device supplied with the caster or, using an existing shop crane.

The semi-automated system comprises: the mould table complete with a set of water cooled moulds (or non-cooled moulds for intermittent small batch production), a set of 'lifting hooks' for sow extraction, an automatic metal feed unit and an operator controlled sow extraction/removal unit.

TABLE & DRIVE: On both fully and semi automatic systems, the mould table indexes one mould position at a time after the completion of each metal pouring operation.

The index movement is powered by an electric motor/reduction gear drive unit which is electronically controlled to give smooth acceleration, rotational movement and deceleration with dynamic braking, ensuring virtually no surface movement of the metal takes place as the table indexes between each mould station, ensuring a smooth, ripple and flash free surface.

FEED UNIT: For both fully and semi-automatic systems, the automatic metal feed unit is located externally to the table perimeter and equipped with a low electric voltage metal level probe/metal pour control system which ensures that all sows are within a consistent weight tolerance. Metal supply to the tilting feed unit can be by direct gravity feed via a launder system or by metal pump.

MOULDS: Either cast iron or cast steel, according to type of metal being cast, which sit in fabricated steel water tanks mounted on the rotating table. On fully automated systems each mould is fitted with hydraulically powered ejector pins to lift each sow partially out of the mould after solidification. Moulds on semi-automatic casters have fittings for the location of manually placed 'lifting hooks'.

SOW REMOVAL/TRANSFER: On fully automatic systems, this equipment is supplied as an integrated unit working in conjunction with the casting machine and comprises: a gantry mounted overhead carriage on which is mounted a pneumatically powered grab unit which lifts the partially ejected sow from the mould then transfers and lowers it onto the storage conveyor. On semi-automatic systems, a pillar jib mounted electric lifting hoist is supplied or the existing overhead shop crane can be utilised.

HOT–TOPS: Fitted over a number of moulds downstream of the metal feed/skimming positions and comprising: a refractory insulated cover over each mould which contains either a gas/air fired burner or electric elements, to maintain heat on the top surface of the metal to help it remain liquid as the rest of the sow cools and contracts, so that the surface cavity which would otherwise form is filled by the liquid surface metal, thus minimising the surface cavity and cracking.

ADDITIONAL – OPTIONAL EQUIPMENT

- **Core Pins**: provision of 'internally water cooled' hydraulically operated 'core pins' in the moulds to produce holes required for handling purposes, particularly for 'galvanising Zn. jumbos'.
- **Mould Drying Unit**: by electric element – blown air heater.
- **Automatic Skimming Unit**.
- **Stamping Unit**: to form a batch and/or metal specification number stamped into the sow having either 8 x 6mm or alternatively 5 x 10mm characters.
- **Weighing Equipment**: an automatic sow weighing system, incorporated into the storage conveyor, complete with a remote free-standing console containing weighing terminal and display unit plus an automatic printer for the production of either self adhesive labels or tally roll print out of each sow weight.
- **Weight Stamping Unit**: as an extra to the above system, the sow weight and an incrementing number corresponding to each sow can be automatically stamped as 10mm high characters into the sow by 'downloading' this information from the weighing terminal processor.

WORLD LEADERS IN INGOT CASTING TECHNOLOGY

Al. Ingots – Cast – Cooled – Stacked – Weighed & Strapped Automatically
at up to 20,000 kg/hr – ***No Ripples, No Flash, Stack Weight ±2%***

8.7m Ø Rotary Ingot Caster
75 moulds for 22.7kg. Al. Ingots at 18,000 kg/hr

Radial Arm Stacker – 22.7kg. Al. Ingots up to 20,000 kg/hr

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WORLD LEADERS IN INGOT CASTING TECHNOLOGY

Pb. Ingots – Cast – Cooled – Stacked – Weighed & Strapped
Automatically at up to 55,000 kg/hr

Rotary Casting Machine & Radial Arm Stacker
Output 25,000 kg/hr

Lift Table Stacker with Automatic Strapping & Weighing
Output up to 55,000 kg/hr.

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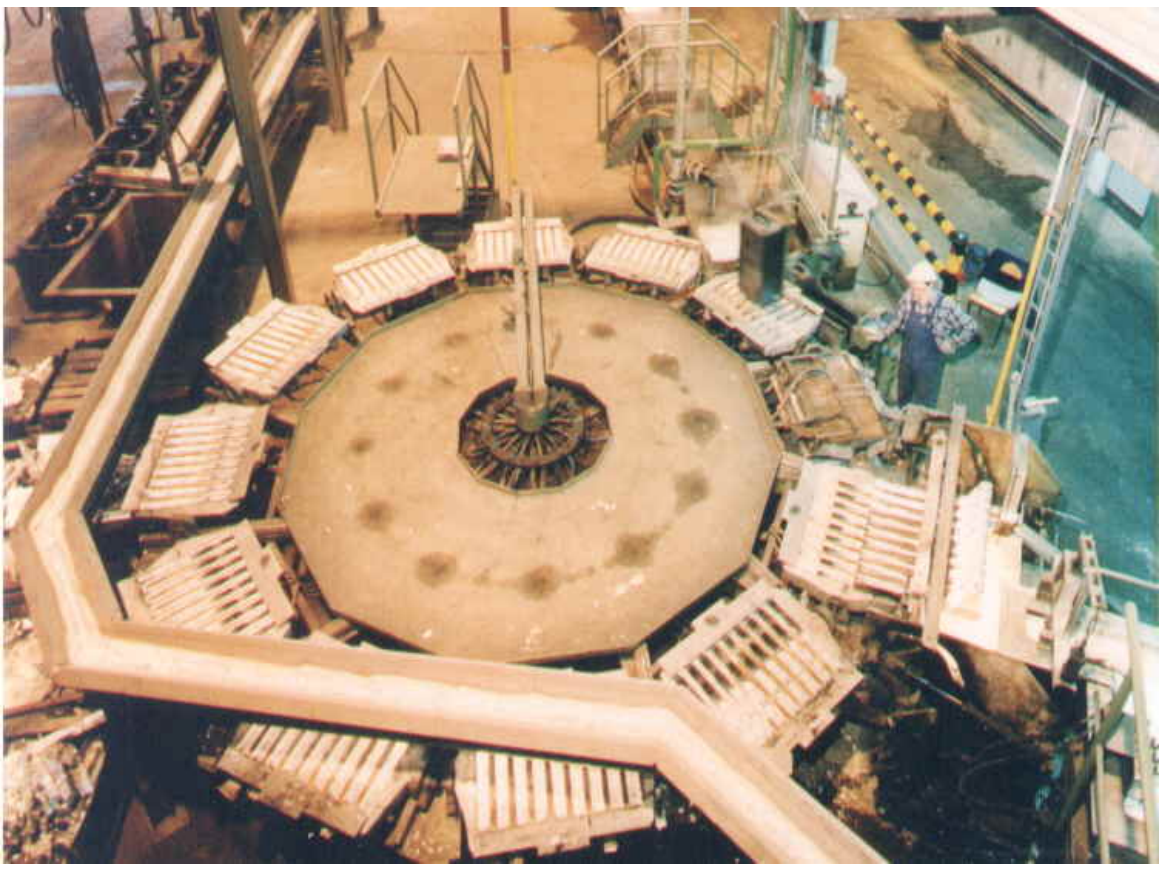
WORLD LEADERS IN INGOT CASTING TECHNOLOGY

Zn. Alloy Ingots – Cast – Cooled – Stacked – Weighed & Strapped Automatically
at up to 15,000 kg/hr of 7kg. Ingots



WE GUARANTEE

No surface ripples

No flash

All ingots produced to a high degree of accuracy

Also available

Casting Machines for 1000kg Zn. Alloy Jumbos & Planks

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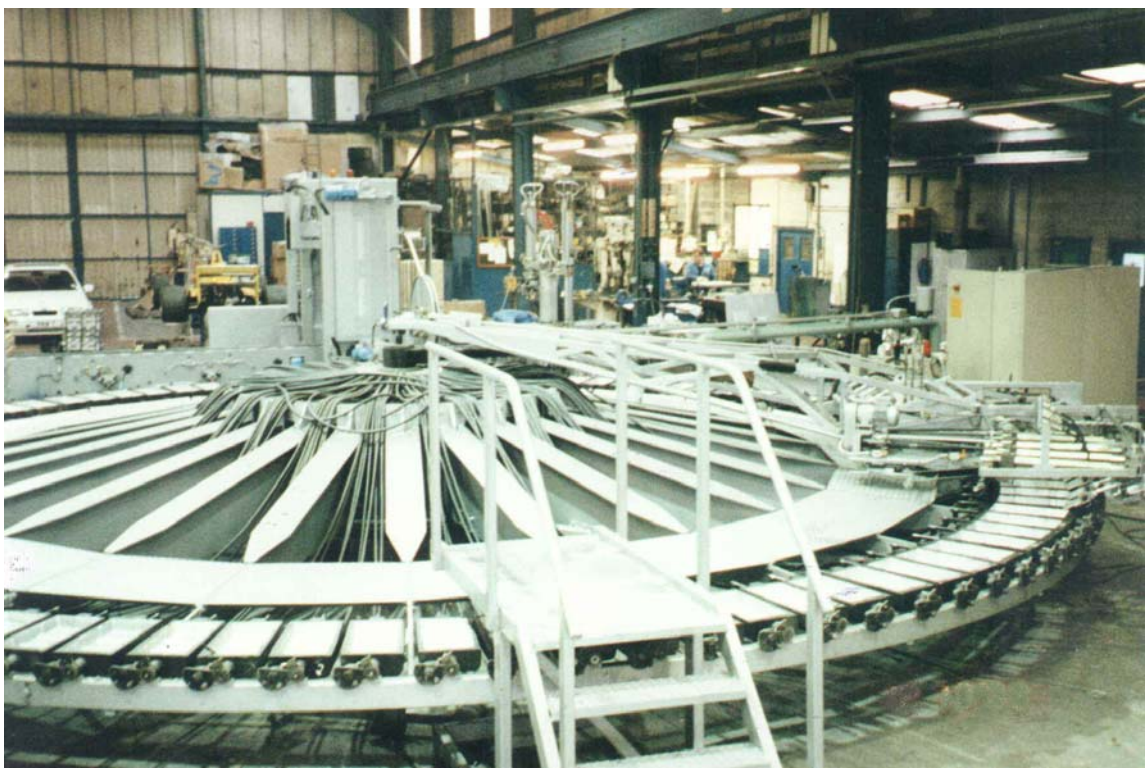
WORLD LEADERS IN INGOT CASTING TECHNOLOGY

Zn. Ingots – Cast – Cooled – Stacked – Weighed & Strapped Automatically at up to 25,000 kg/hr



9.7m Ø x 96 mould rotary caster for 25,000 kg/hr output

Typical 1000kg Zn. Slab Stack

WE GUARANTEE

No ripples on surface of ingot

No flash on edges of ingot

Also available

Automated Production Equipment for 1000kg Zn. Jumbos & Planks

** VIDEO AVAILABLE **

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MAGNESIUM (Mg.) INGOTS – CAST – COOLED – STACKED – WEIGHED & STRAPPED AUTOMATICALLY

Casting Conveyors with Air Cooled Moulds
Primary Mg. Ingots or Secondary Mg. Alloy Ingots
Automated Production Systems up to 8 t/h capacity

Mg. Ingots produced on "WORSWICK" Machine - without skimming

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WORSWICK

Mg. INGOT CASTING MACHINE

Following the large increase in demand for Magnesium ingots, world-wide conventional thinking was to use conveyor type – casting machines as had been previously used for Aluminium and Zinc etc. However, because water cooling of the moulds is not possible with Magnesium the conventional straight-line conveyor type machines are very long in order to allow sufficient time for cooling of the moulds on the return strand. One alternative in the past has been to spray this return strand with water, however this tends to cause large quantities of steam, which necessitates large ducting and steam extraction equipment.

The solutions to these problems has been proven by Worswick Engineering Ltd., who have been supplying internally water-cooled moulds mounted on a rotary table for over 40 years and this expertise has proved invaluable when applied to the production of Magnesium ingots.

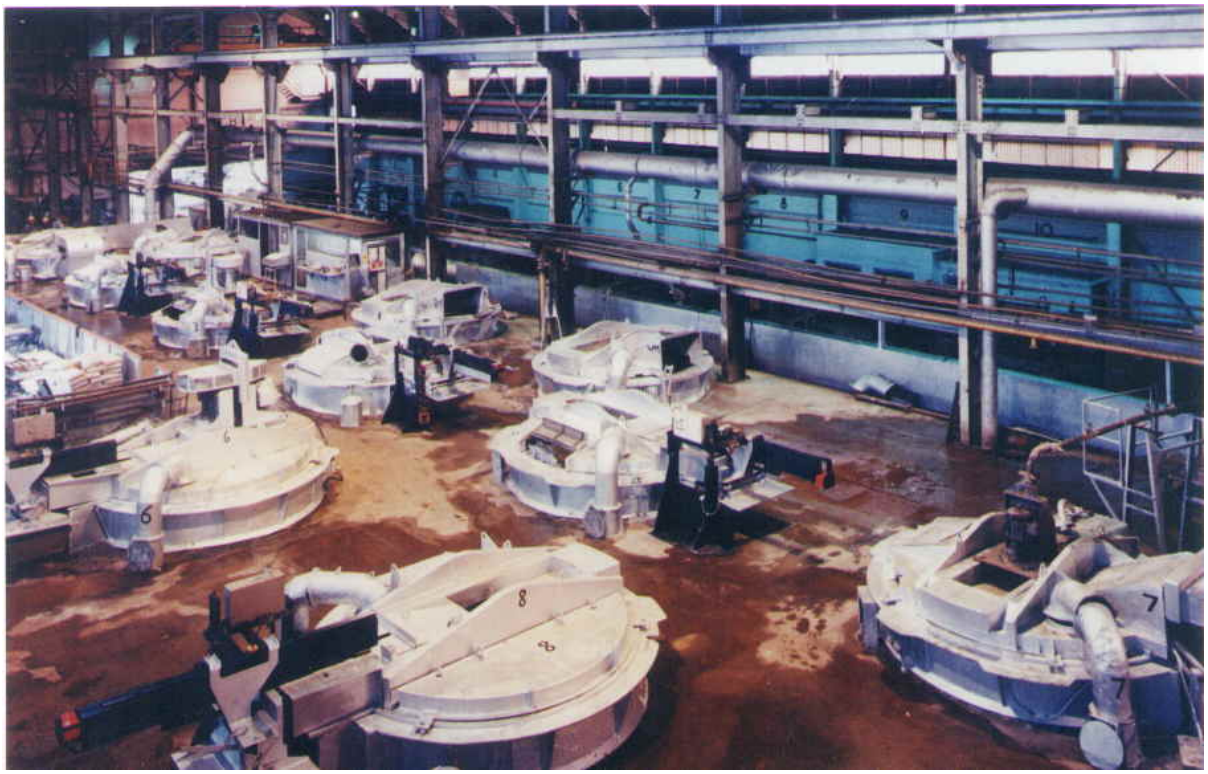
A casting machine consists of a rotary table on which are mounted a number of moulds with each mould typically forming a segment of a full circle and each mould may contain a number of mould cavities. Because the moulds are internally water cooled, the machine can cast indefinitely at its rated output, compared with conventional conveyor type machines, which have a gradually reducing output as the mould temperature increases. Due to the fact that the moulds are sealed and internally water-cooled there is no steam or water evaporation and therefore no requirement for extraction equipment. The moulds are designed to be easily removed allowing quick and easy change of ingot size or weight in less than 30 minutes.

One further advantage that customers have been enthusiastic about is that a rotary machine typically takes up much less space than a conveyor type due to the high efficiency of its water cooled moulds and the fact that it uses all of its moulds during the production process, whereas a typical conveyor machine has over 50% of the moulds unused on the return strand (underside) of the machine.

By way of example, a typical straight line conveyor type machine for 4000 kg per hour would be 16.4 metres long, however a rotary machine to produce the larger output of 5000 kg per hour is only 5.5 metres in diameter.

As with all of the “Worswick” range of ingot casting machines they can be fully integrated with automatic stacking, strapping and weighing equipment to suit the customers needs and factory layout.

AUTOMATIC LEAD DROSS REMOVAL MACHINE



Previously, removing dross from the lead surface was an arduous task, requiring two men, one of whom would rake the dross surface across the face of the lead through one aperture to the area in which the other worker would use a drossing spoon to lift the dross, allow it to drain and pivot the drossing spoon on a drossing horse to facilitate tipping the dross into a dross bin. Due to the arduous physical nature of the job, back injury was a major risk of the occupation and also great care had to be taken as to the safety requirements of the workers whose close proximity to the lead needed to be carefully controlled.

With the new drossing machine installed in conjunction with the customer arranging low speed rotation of the metal, all that is required of a man is a supervisory role, whereby the drossing machine is started and allowed to go through an adjustable timed cycle and, upon finishing the duration of drossing time pre-set, it sounds an alarm to summon attention to inspect the pot to see whether further drossing is required or, after a minute, the alarm stops and the drossing machine returns to the start position and awaits a further start instruction for the next drossing cycle.

For ease of access and also if necessary, interchangeability of drossing machines between various pots, the drossing machine is supported in a cantilevered fashion on a central pivot which not only allows rotation of the machine away from the vicinity of the pot, but allows the drossing machine to be lifted between two or mote separate stands so that for situations where there is not a great throughput of dross on each pot, it may be possible to move the drossing machine between pots. This being easily accomplished by slinging the drossing machine from a crane via it's three lifting eyes.

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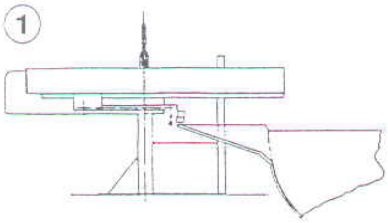
SEQUENCE OF OPERATION

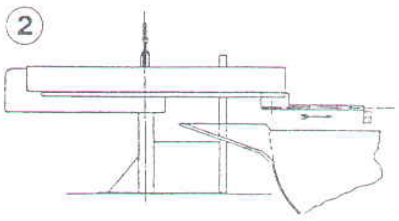
The rake, during its normal sequence starts in position 1 in a lifted and back position at the edge of the beach. The first movement (position 2) is a short stroke forward which on further cycles is gradually increased to take dross from nearer the centre of the refining pot, and position 3 allows the rake to be lowered onto the dross surface and is driven down by an adjustable air pressure which is reacted against by the buoyancy of the float attached to the drossing rake, thereby adjusting the depth of penetration of the rake into the lead dross. In position 4, the lead dross is drawn back slowly over the lead surface and pulled up the beach which can either be incorporated into the pot or hung over the side as required, and at position halfway up the beach, the rake pauses to allow any entrained metal to flow back down the beach into the lead pot. In position 5 the rake continues its movement up the beach, pulling with it the drained dross which is pulled over the edge of the beach into a dross bin or a drossing chute. The cycle then nominally returns to position 1 except selecting a slightly larger forward stroke, which is one of three strokes available all of which can be screwdriver adusted inside the panel for length of travel, to suit individual requirements of the application. If however, the drossing machine fails to move from position 3 to position 4, due to some obstacle in the drossing path, either exceptionally heavy dross or possibly part of the furnace lining, the drossing machine will then lift, more forward a short distance, lower and try again three consecutive times and if it still proves impossible to return to position 4, the drossing machine will lift and retract and return to position 1 in the programme and sound an alarm to summon the supervisor to intervene manually to remove the offending blockage.

The drossing machine has been manufactured with adustability of all movements a prime consideration so that speed of travel forwards and backwards, rake lift and lower and cushioning at end positions are all adjustable as are the timed durations of the forward strokes of the rake and the air pressure to effect penetration of the dross in position 3. The height of the machine's central stanchion is also variable, so as to best set the machine up to the lead pot dimensions. The machine is controlled by use of a minimum number of signals due to its sophisticated nature, and utilises only start/stop, timer reset and emergency stop pushbuttons to operate.



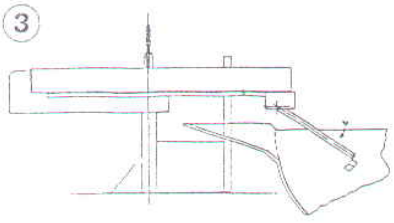
START POSITION

Rake Back & Up.



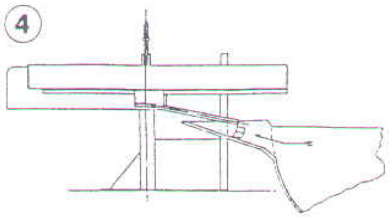
RAKE EXTEND

Three Incrementing Strokes.



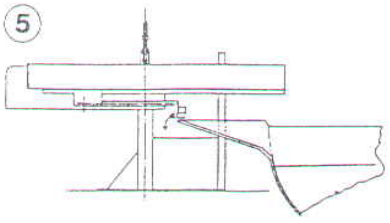
RAKE LOWER

Lead surface is found by the float on the rake counteracting the downward pneumatic pressure.



RAKE RETURNS TO BEACH

Rake pauses half way up beach to allow free lead to drain back.



CYCLE FINISH

Rake pulls dross over the edge of the beach into a dross bin or chute.

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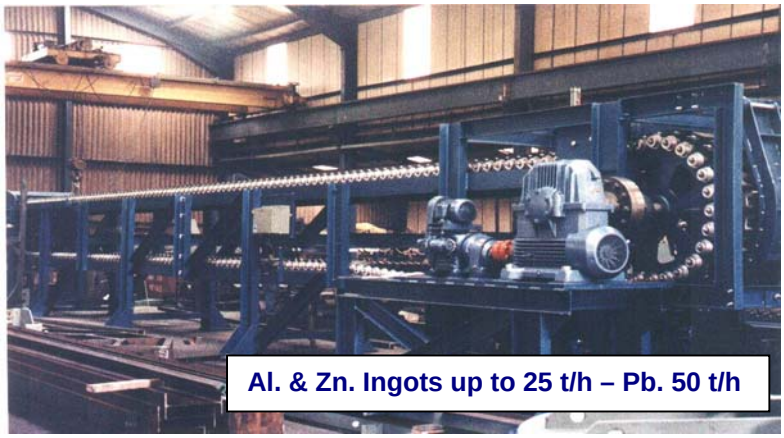
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