

[54] **ARTICLE FORMING MACHINE AND EXTRACTOR**

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[51] Int. Cl. **B22d 29/04**

[58] Field of Search..... 164/344, 404, 154;
425/436, 444; 214/1 BD, 1 BB, 1 BV;
74/110, 469

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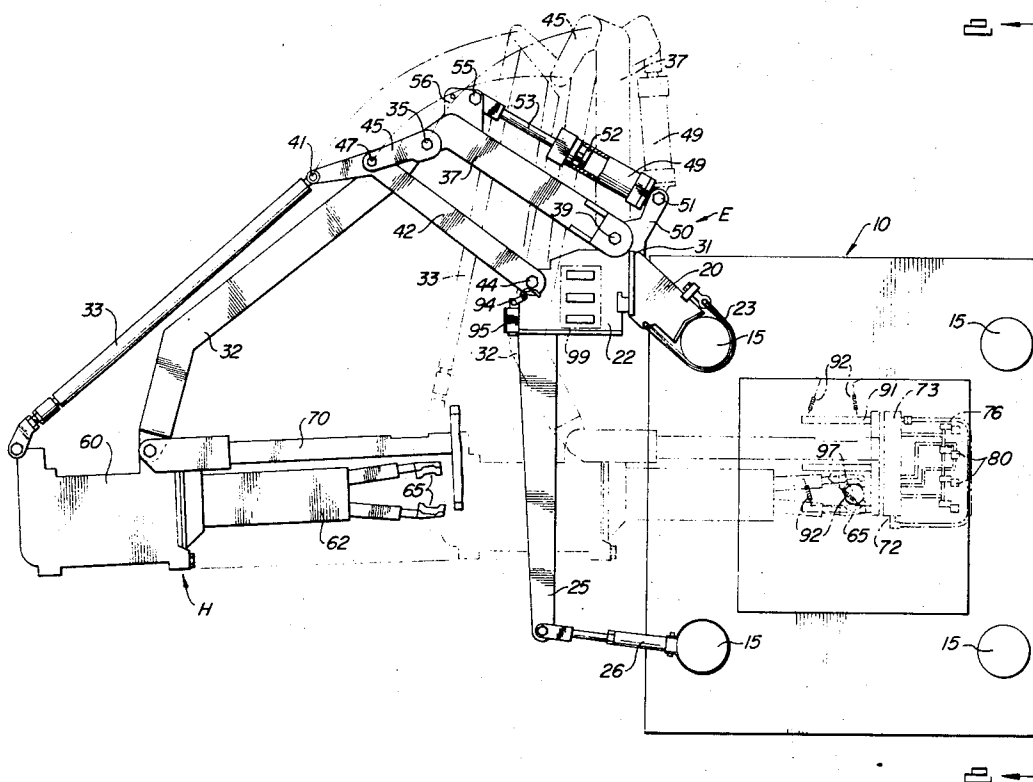
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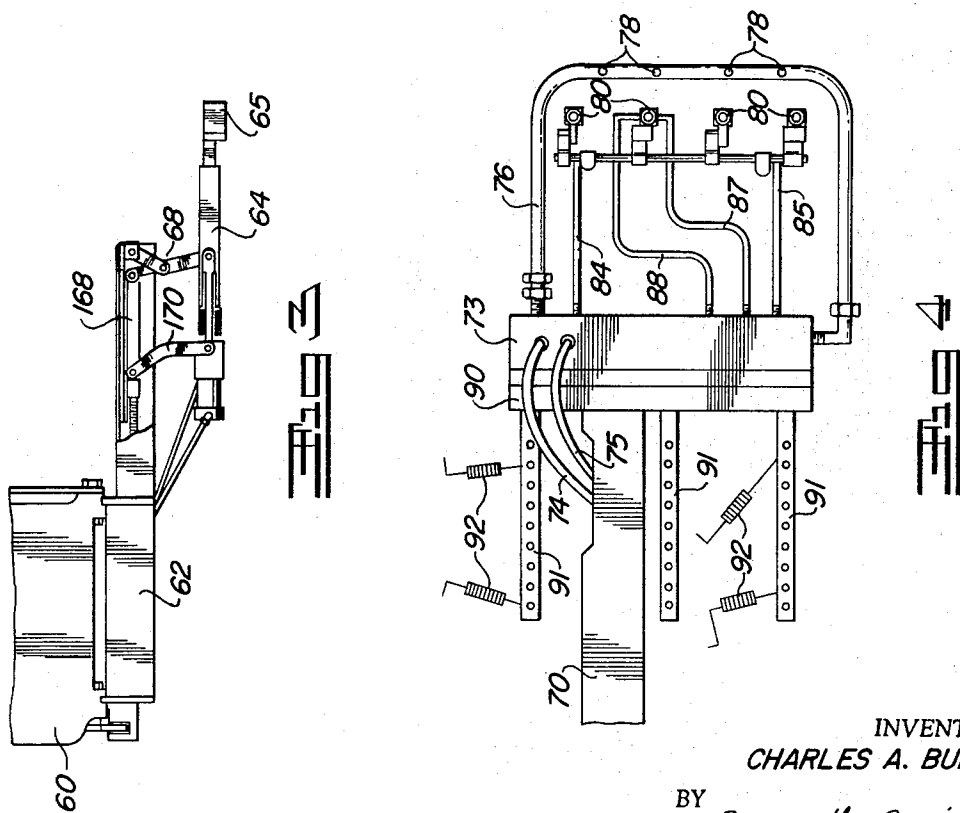
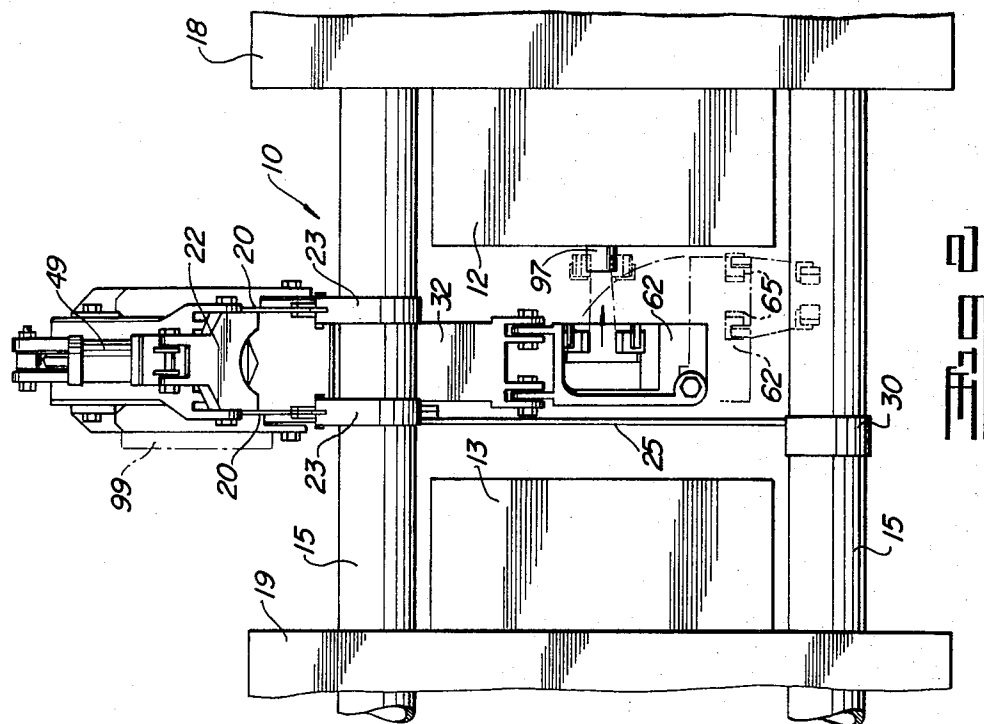
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[57] **ABSTRACT**

A machine for extracting formed articles from an article forming machine, such as castings from a die casting machine. The extractor is mounted on the article forming machine above the article forming area and has pivotally connected arms that extend transversely of the article forming area and carry an extractor head. The arms swing the extractor head into and out of the article forming area in synchronism with article forming cycles of the machine. Formed articles are grasped by means on the extractor head, and released when the extractor head is retracted from the forming area. The extractor head also carries means by which the article forming members may be cleaned and lubricated as the extractor head is retracted. Sensing means are provided on the extractor head to sense incomplete articles.

12 Claims, 12 Drawing Figures

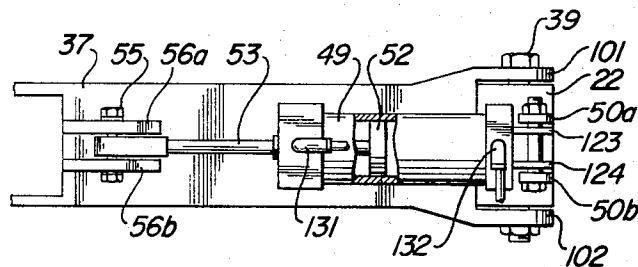
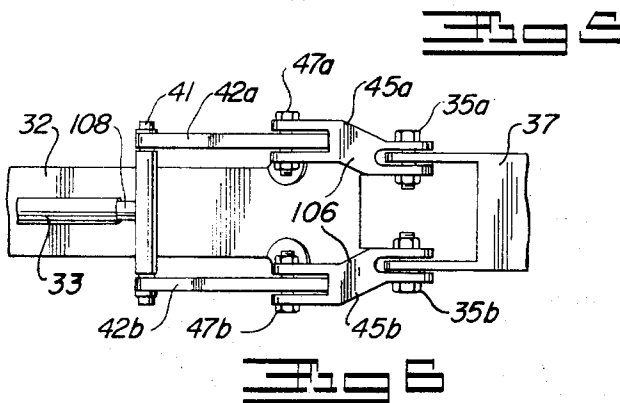
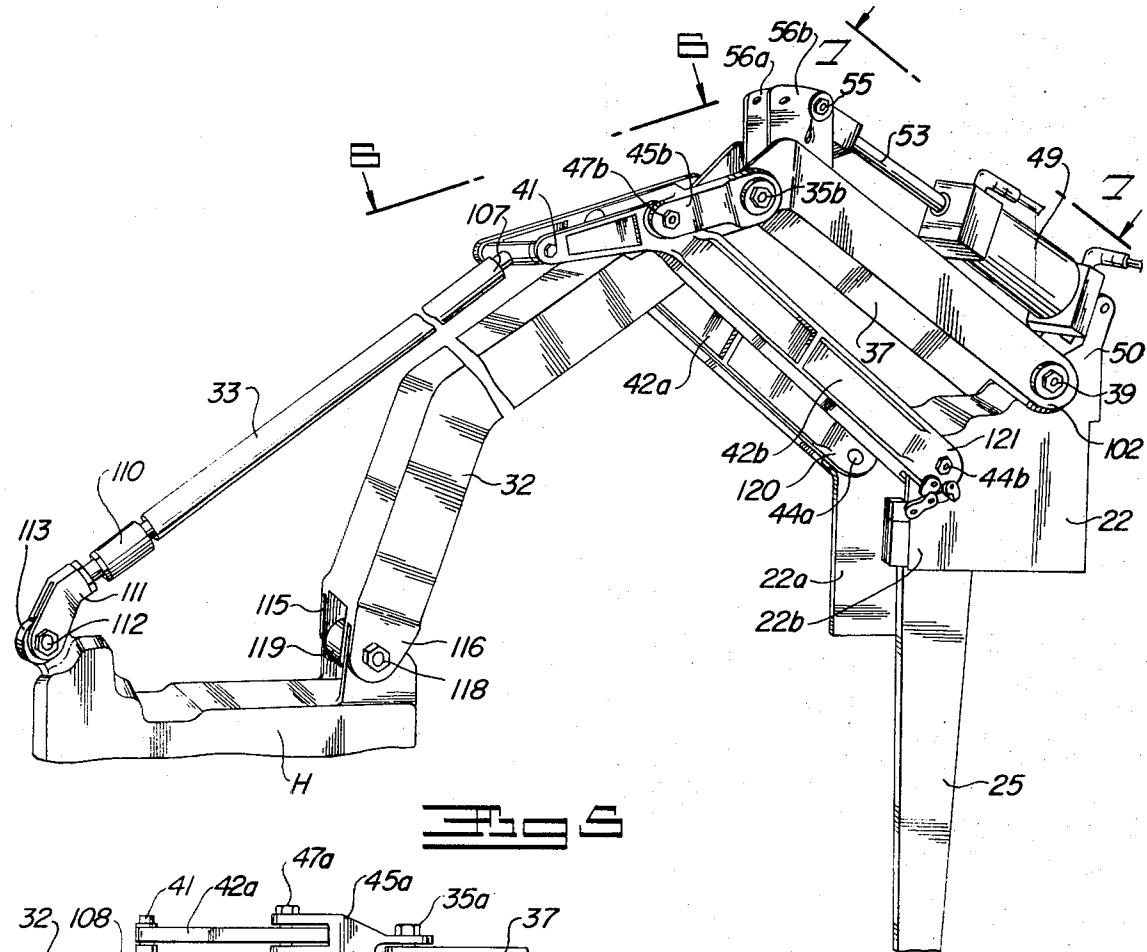




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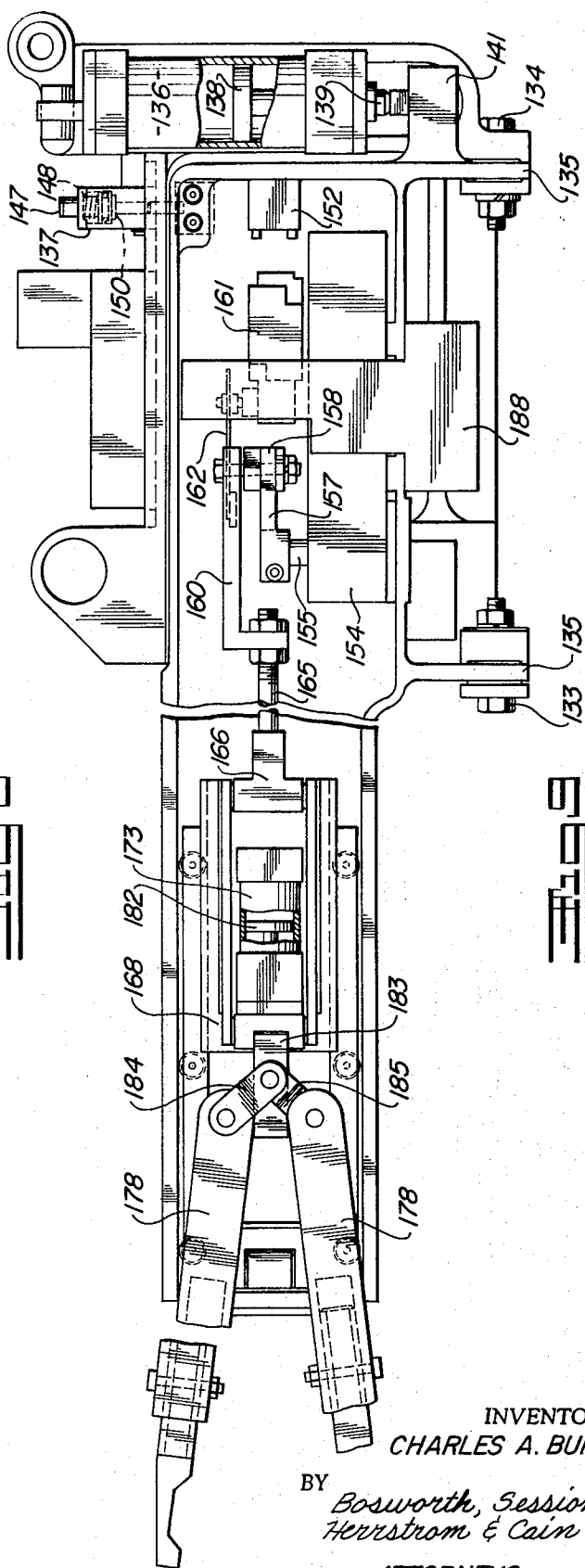
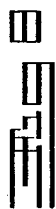
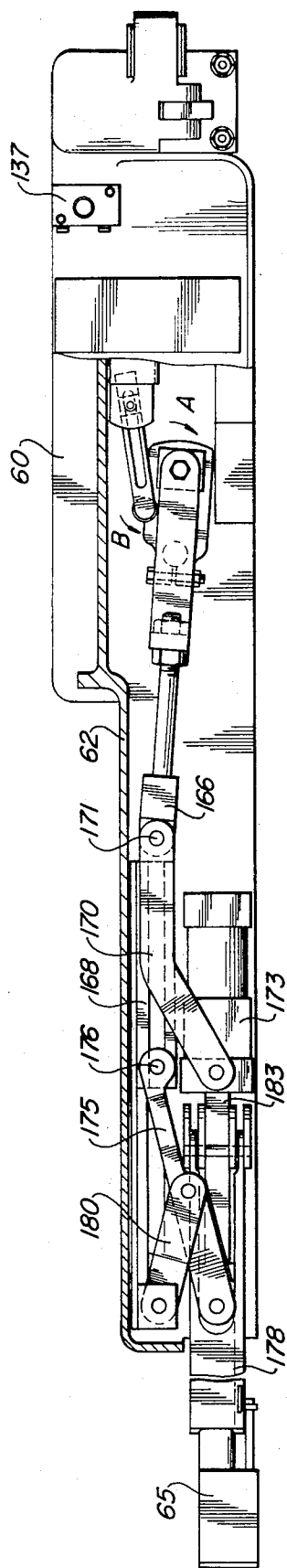
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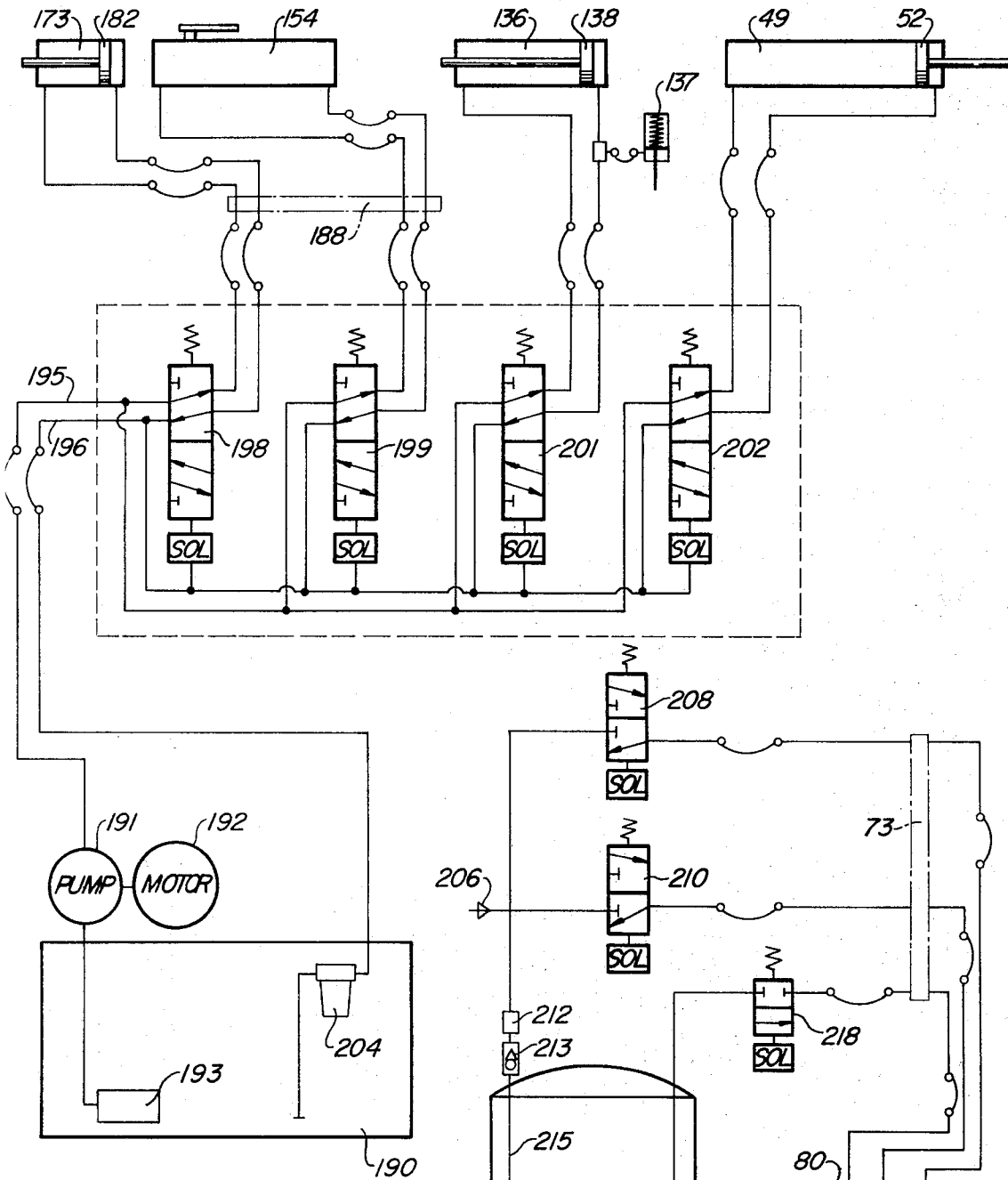


Fig. 10

Fig. 10A

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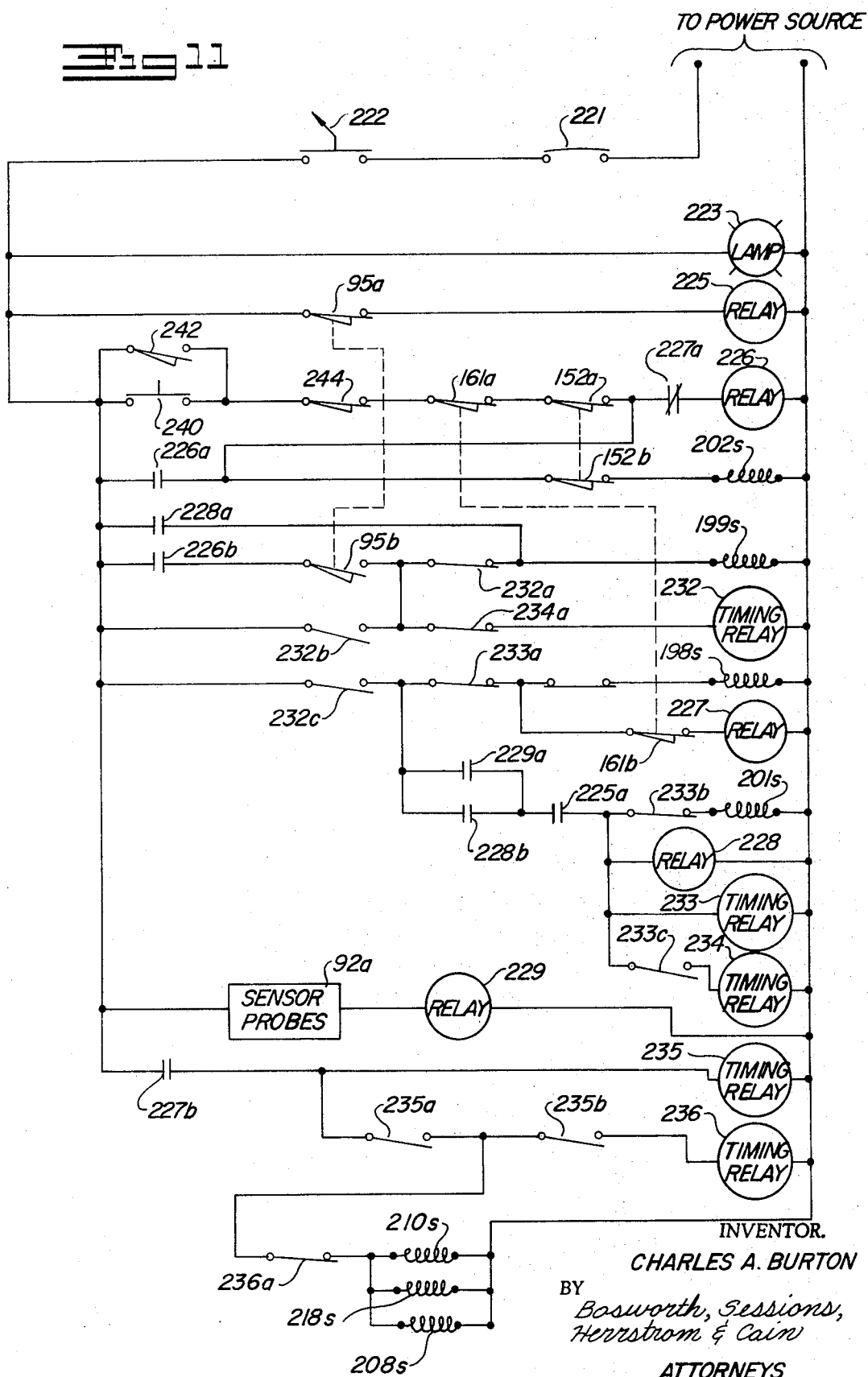
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Fig 11



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ARTICLE FORMING MACHINE AND EXTRACTOR

BACKGROUND OF THE INVENTION

This invention relates to the handling of articles and more particularly to the removal or extraction of formed articles from an article forming machine, such as die castings from a die casting machine.

In industrial forming processes such as the molding and casting of metals and other materials it is common practice to employ a machine to extract formed articles from the article forming machine. Such article extracting machines are synchronized with the operation of the article forming machine, such as a die casting machine, and are adapted to extend an extractor arm between the spaced platens of the casting machine, grasp the die casting, retract the arm and release the casting onto a conveyor belt or into a receptacle or quenching bath. Additional capabilities have been provided to such machines culminating in recently proposed machines which are actually industrial robots that are programmable to automatically proceed through a complex set of operations.

It is also known in industrial forming processes to apply a lubricant, such as by spraying, to the working surfaces of the dies or molds between forming cycles. Other operations, such as blowing air against the forming surfaces to remove any residual scale that may remain around the die cavities and to cool the surfaces, may be performed while the die or mold sections are separated. In most cases separate machines have been employed for the air blowing and lubricant spraying operations on the one hand and for the article extracting functions on the other hand.

Another function usually performed in the die casting extraction is the detection of missing parts of a casting. Automatic sensing of an incomplete casting immediately after it has been removed from the die is highly advantageous, if not an actual necessity. For this purpose, casting sensors can be attached to the extractor arm so that the absence of a section of casting can be detected while the extractor arm is being retracted out of the die area.

Performance of the operations described above by machines rather than manually is advantageous from both the standpoint of cost and safety. The safety aspect is particularly significant since the use of machines avoids the necessity of having a worker move between the opposed platens of an article forming machine between cycles thereof.

Despite the range of their capabilities all prior article extracting machines of which I am aware have embodied a mounting base positioned directly in front of the article forming machine and some form of extractor arm mounted on the base and adapted to be extended forwardly into the die area to extract the formed article. In many of the machines the extractor arm is pivotable in a horizontal plane about a point on the mounting base. The formed article can thus be extracted from the article forming machine and then placed onto a conveyor or into a receptacle.

A principal disadvantage of these prior extractors is the amount and location of the floor space required when in operation. In any industrial plant space is at a premium and must be used to the best advantage. This is particularly true adjacent a large machine which must be attended by other machines.

Another disadvantage with prior article extracting machines is in the cost required to make them capable of both arcuate and linear movement both vertically and horizontally. In prior machines it has been necessary to provide capability for these different types of movements in order for the machine to be capable of its fundamental task of extracting a formed article and depositing it on a conveyor or in a receptacle.

SUMMARY OF THE INVENTION

A general object of this invention is to provide an article extracting machine that overcomes the above noted disadvantages in prior article extracting machines. A more particular object is to provide an article extracting machine that is adapted to be mounted on an article forming machine and requires substantially no floor space while performing all tasks expected of an article extracting machine.

Another object is to provide such an article extracting machine having an extractor head that is supported from above and which may be swung in substantially a straight line into and out of the article forming area.

Another object is to provide an article extracting machine that has provision for performing all extracting and related operations in essentially one motion such as extracting, article sensing, die spraying and article depositing.

Yet another object is to provide an improved article extracting machine, particularly adapted for use with die casting machines, that is simple but efficient in construction, economical to manufacture, and efficient and economical to use.

In a preferred embodiment the article extractor of this invention includes a driving arm, means pivotally supporting the driving arm, an extractor head adapted to be moved into and out of the article forming machine to extract formed articles therefrom and a support arm pivotally connected to the extractor head. The driving arm and the support arm are pivotally connected together at their outer ends. Driving means is provided to cause the driving arm to pivot with respect to the support means. The pivotal connection of the driving arm with the support arm causes the pivotal movement of the driving arm to be converted to linear movement of the extractor head which is caused to move into and out of the article forming machine to extract formed articles therefrom.

Preferably, an idling arm is also pivotally connected to the support means and stabilizing arm is pivotally connected to the extractor head spaced from the support arm. The connecting means then pivotally connects together the driving arm, support arm, stabilizing arm and idling arm.

The extractor head includes a clamping mechanism and, preferably, includes means by which the clamping mechanism can be extended laterally of the path of movement of the extractor head to more conveniently clamp a formed article. Preferably, the clamping mechanism and the extending means are part of a roll assembly on the extractor head which is caused to rotate 90° after the extractor head has been retracted from the article forming area to facilitate release and deposit of the formed article.

The extractor head may support a spray-blow head by which the article forming means are sprayed with cleaning and lubricating fluid, and may also support ar-

title sensing means which determine whether there are any portions missing of the formed article.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of an article extractor embodying this invention mounted on a die casting machine.

FIG. 2 is an end elevational view of the extractor and machine taken generally along line 2—2 of FIG. 1.

FIG. 3 is a side elevational view of the extractor head of the article forming machine showing the roll assembly rolled down and the article clamping mechanism extended.

FIG. 4 is a side elevational view to a larger scale than shown in FIG. 1 of the spray-blow head and article sensors.

FIG. 5 is a perspective view of the driving and support arm arrangement of the article extractor.

FIG. 6 is an elevational view taken along the line 6—6 of FIG. 5.

FIG. 7 is an elevational view taken along the line 7—7 of FIG. 5.

FIG. 8 is a top elevational view of the extractor head assembly with portions of the housing broken away to show the roll assembly and extend and clamp mechanisms.

FIG. 9 is a side elevational view of the extractor head assembly with the cover removed to show the roll assembly and extend and clamp mechanisms.

FIG. 10 is a diagram of the hydraulic circuit of the article extractor.

FIG. 10A is a diagram of the spray-blow circuit by which spray air, blow air and liquid are delivered to the spray-blow head.

FIG. 11 is a schematic diagram of the electrical control circuit for the article extractor.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and initially to FIGS. 1, 2 and 3 an article extractor embodying this invention is shown mounted on a die casting machine generally indicated at 10 which includes a fixed die platen 12 and a movable die platen 13. Movable platen 13 is adapted to be moved toward and away from fixed platen 12 in repetitive casting cycles with an article being formed between the platens on each casting cycle. The die casting machine 10 is provided with conventional tie bars 15 that extend between spaced supporting portions 18 and 19 of the machine.

The article extracting machine generally designated E is mounted on a pair of the tie bars above and slightly to one side of the die casting area. The extractor E is connected to the upper tie bar 15 of the pair by means of mount weldments 20 which extend from the main support housing 22 of extractor E and are clamped to the upper tie bar by means of support band arrangements 23. A support leg 25 also extends from main support housing 22 and is connected at its lower end to a length-adjustable support strut 26 which is, in turn, connected to a support band arrangement 30 clamped around the lower tie bar 15. The extractor E is located precisely with respect to the center line of the sprue of castings to be extracted by constructing mount weldment 20 so that vertical and horizontal planes passing through point 31 on the weldment are at precise distances from the respective center lines of the sprue.

An extractor head assembly generally designated H is supported from above and moved in a substantially straight line into and out of the die casting area to extract cast articles therefrom in synchronism with the operation of the die casting machine 10. The extractor E thus requires essentially no floor space alongside the die casting machine and when the extractor head assembly H is out of the die area the dies and other parts are easily accessible for maintenance and replacement. Also, since the extractor is mounted on the die casting machine itself, the precise position of the extractor with respect to the sprue of castings to be extracted will not change during operation due to shifting or vibration of the casting machine or extractor.

The extractor head assembly H is largely supported by a primary support arm 32 and is stabilized and partially supported by a stabilizing arm 33. Primary support arm 32 is pivotally connected as by bolt 35 to a driving arm 37 which is pivotally connected by bolt 39 to main support housing 22. Stabilizing arm 33 is pivotally connected by bolt 41 to an idling arm 42 which is pivotally connected at its other end to main support housing 22 by bolt 44. Idling arm 42 and driving arm 37 are connected by a pivot link 45 which is connected to driving arm 37 by bolt 35 and to idling arm 42 by bolt 47. Pivot link 45 is integrally connected to primary support arm 32 as explained below. A driving cylinder 49 is connected to move driving arm 37 and is pivotally connected to main support housing 22 at one end by a support member 50 and a bolt 51. A piston 52 is reciprocable within driving cylinder 49 and has a piston rod 53 pivotally connected by means of bolt 55 to a support member 56 that is welded or otherwise suitably affixed to driving arm 37.

By means of this driving and support arm arrangement the extractor head assembly H can be moved in a substantially straight line from its normal position outside the die casting area as shown in full lines in FIG. 1 into the die casting area as shown in dashed lines in FIG. 1 to extract a cast article from the fixed die platen. The extractor head assembly is moved by supplying hydraulic fluid to cylinder 40 to cause piston rod 53 to be retracted therein. Retraction of piston rod 53 pivots driving arm 37 and idling arm 42 about bolts 39 and 44, respectively. Primary support arm 32 and stabilizer arm 33 are thereby caused to pivot about bolts 35 and 41, respectively, and move extractor head assembly H toward the die casting area. The geometry is such that the pivotal motion of arms 37 and 42 is converted into substantially straight line motion of extractor head assembly H.

The extractor head assembly H is retracted from the die casting area by supplying hydraulic fluid to driving cylinder 49 to extend piston rod 53 from the driving cylinder. The extractor head assembly H is thereby moved in substantially a straight line from the die area.

The movement of extractor head assembly H into and out of the die area is done in synchronism with the casting cycles of die casting machine 10. Operation is such that as movable platen 13 moves away from fixed platen 12 leaving a cast article in the die of the fixed platen, the extractor head assembly H is extended into the die casting area, grasps the sprue or biscuit of the casting and is retracted from the die area to await the next signal to extract a casting. As the casting is extracted, it is sensed by sensors mounted on the extractor head assembly to ensure that the complete casting

has been extracted from the die. Also as the extractor head assembly H is retracted, the die may be sprayed with air and liquid to cool, clean and lubricate the die by a spray-blow head also mounted on the extractor head assembly H.

After the extractor head assembly H is retracted, the casting is released onto a conveyer or into a receptacle and this step preferably includes causing a portion of the extractor head assembly to rotate 90° from its extracting position so that the casting can be easily released without a significant chance of having the casting cling to the clamping jaws. The extractor head assembly and its operation in the die area in grasping the casting and outside of the die area in releasing and depositing the casting are described below.

The extractor head assembly H includes a support housing 60 and roll assembly generally designated 62 which is pivotally connected to the support housing 60 and adapted to be pivoted to a position at 90° with respect thereto as shown in FIG. 3. Roll down of assembly 62 is initiated by a hydraulic cylinder in support housing 60 as explained below. Roll assembly 62 includes a clamping mechanism 64 having clamping jaws 65 and an extend mechanism 68 by which the clamping mechanism 64 is extended outwardly. In FIG. 3 the roll assembly 62 is rotated from its upright position and the clamping mechanism 64 is extended. This is the position assumed after the extractor head has been retracted from the die area and the casting is to be deposited. The rotation of roll assembly 62 and extension of clamping mechanism 64 facilitates depositing the casting without damage thereto. When the extractor head is within the die area about to grasp a casting the roll assembly is upright and the direction of extension of the clamping mechanism 64 is laterally toward the casting. The operation is described in greater detail below.

The extractor head assembly H also includes a spray-sensor boom 70 which is mounted on the support housing 60 and extends outwardly beyond the clamping jaws 65 as shown in FIG. 1. At its outermost end, boom 70 supports a spray-sensor assembly generally indicated at 72 and shown in detail in FIG. 4.

Assembly 72 includes a spray-blow head including a manifold 73 to which compressed air and liquid are introduced through conduits 74 and 75 to be delivered to spraying and blowing apparatus. A blow tube 76 is connected to the manifold 73 to receive air therefrom and is provided with a plurality of holes 78 through which compressed air is blown onto the die to clean it and to assist in distributing the liquid that is sprayed thereon. A series of spray nozzles 80 are mounted on a rod 82 which in turn is supported by two support rods 84 and 85 which are connected to and supported by manifold 73. The nozzles 80 are of the air spray type and each is supplied with liquid to be sprayed through a conduit 87 connected to one side of the nozzle and is supplied with atomizing air through a conduit 88 connected to the opposite side of the nozzle as shown in FIG. 4. A pair of conduits 87 and 88 is provided for each of the nozzles 80 but only one such pair of conduits is shown.

Spray-sensor assembly 72 also includes a sensor base 90 having sensor probe support arms 91 extending rearwardly therefrom as shown best in FIG. 4. The support arms 91 support sensor probes which, in this illustrative embodiment, are in the form of springs 92 arranged on the support arms 91 in a proper pattern to contact all portions of a complete die casting. Sensing

is accomplished by passing a small electric current serially through the probes 92 and through the completed die casting so that a circuit is completed if no parts of the die casting are missing. If the circuit is not completed then a part of the die casting is missing and operation of the die casting machine 10 and the extractor E is temporarily halted while the missing portion of the casting is removed from the die or otherwise located.

Operation of the extractor E is synchronized with operation of the die casting machine 10 and begins when movable platen 13 is moved away from fixed platen 12 and operates a limit switch (not shown) indicating that a casting has been formed and is ready to be extracted. Extractor E at that time is in the full line position shown in FIG. 1 and, upon actuation of the limit switch by movable platen 13 a solenoid controlled valve is operated and causes hydraulic fluid to be supplied to driving cylinder 49 to retract piston rod 53 into the cylinder. Extractor head assembly H is thereupon moved into the die area to the dashed line position of FIG. 1. When the extractor head assembly H is extended completely into the die area idling arm 42 strikes a cam 94 mounted on main support housing 22 which actuates a limit switch 95 also located on the main support housing.

Actuation of switch 95 operates another solenoid controlled valve and causes clamping mechanism 64 to be extended laterally by extend mechanism 68 toward the sprue 97 as indicated in dashed outline in FIG. 2. Extension of clamping mechanism 64 initiates a time delay and after that delay a solenoid controlled valve for clamping mechanism 64 is actuated and causes jaws 65 to clamp the sprue 97. After another time delay extend mechanism 68 is caused to retract clamping mechanism 64 to its original position. Clamping mechanism 64, in moving to its original position, actuates a limit switch that operates the solenoid controlled valve for drive cylinder 49 and causes retraction of extractor head assembly H out of the die area.

As clamping mechanism 64 is moved from its extended to its normal position holding the casting, the casting is moved into contact with the sensor probes 92 as seen best in FIG. 1. As the extractor head assembly H begins to be retracted out of the die area sensing of the casting is begun and, if the casting is incomplete, the casting and extracting operation will be temporarily halted to locate the missing portion of the casting. Also, while the assembly H is being retracted out of the die area air and fluid are supplied to the spray-blow manifold 73 and the die is sprayed with liquid and blown with air to clean, cool and lubricate the die as the spray-sensor assembly 72 moves past it.

When the extractor head assembly H is completely retracted out of the die area idling arm 42 strikes cam 94 and actuates limit switch 95 to its opposite position and causes operation of the solenoid controlled valve for the roll assembly 62. The roll assembly is thereupon caused to roll down to the position shown in FIG. 3 and shown in dashed lines in FIG. 2. The extend mechanism 68 is also actuated and causes clamping mechanism 64 to extend outwardly and, since the roll assembly 62 is in the rolled down position, clamping mechanism 64 is extended downwardly to the lower position shown in dashed lines in FIG. 2. The clamping mechanism 64 is then caused to release the casting onto a suitably positioned conveyor or into a receptacle. Clamping mechanism 64 is then retracted to its original position and roll assembly 62 is rolled up to its original position to await

the completion of another casting cycle of die casting machine 10.

It will be apparent that all of the procedures described above are not essential to the extracting operation. For example, the spray-blow operation is not essential in all cases, although it is highly advantageous to perform these functions simultaneously with the extraction of the completed casting. Likewise, it is not essential that roll assembly 62 be rolled down in order to release the casting. It is, however, highly advantageous and ensures that the casting will not be caught on the clamping jaws 65.

As indicated above, movements of the various portions of the extractor are controlled by hydraulic cylinders which are in turn controlled by solenoid operated valves. These valves may conveniently be mounted on a valve plate and supported on the main support housing 22 as shown in dashed lines at 99 in FIGS. 1 and 2.

The construction of the extractor driving and support arm arrangement and of the extractor head assembly H including the roll assembly, the extend mechanism and the clamp mechanism will be described in greater detail below. The hydraulic and electrical control circuits for the extractor will also be described.

Driving and Support Arms

Referring now to FIGS. 5, 6 and 7, driving arm 37 terminates at its lower end in a pair of flanges 101 and 102 which bracket the main support housing 22 and are pivotally connected thereto by means of bolt 39. Driving arm 37 is provided at its upper end with similar flanges 104 and 105 which are connected by means of bolts 35a and 35b to pivot links 45a and 45b. Pivot links 45a and 45b are formed integrally with primary support arm 32 as indicated at 106 in FIG. 6 and, in addition to being connected to driving arm 37, are connected to angled portions of idling arms 42a and 42b by bolts 47a and 47b. The angled portions of the idling arms 42a and 42b are connected together by means of bolt 41. A sleeve 107 is received over bolt 41 and has an integral rod portion 108 to which the stabilizing arm 33 is pinned or otherwise suitably connected.

Stabilizing arm 33 is provided at its lower end with an adjustable coupling member 110 which couples the stabilizing arm to a clevis 111. Clevis 111 receives the bolt 112 and bearing 113 to pivotally connect stabilizer arm 33 to the extractor head assembly H. Coupling member 110 allows the length of stabilizing arm 33 to be adjusted so that the extractor head assembly H will pivot about its connection with primary support arm 32 to position clamping jaws 65 precisely with respect to the sprue of castings to be extracted.

Primary support arm 32 is connected to driving arm 37, idling arms 42a and 42b, and stabilizer arm 33 as described above. The support arm is provided at its lower end with flanges 115 and 116 which receive a bolt 118 and bearing 119 to pivotally connect the primary support arm to extractor head assembly H.

Idling arms 42a and 42b are connected to driving arm 37, primary support arm 32 and stabilizer arm 33 as described above. The idling arms are connected at their lower ends to plate-like portions 22a and 22b, respectively, of main support housing 22 by means of bolts 44a and 44b.

Driving cylinder 49 is connected to main support housing 22 by means of flanges 123 and 124 which are connected by bolt and nut 126 to flanged portions 50a and 50b of support member 50 on main support hous-

ing 22 as best seen in FIG. 7. The piston 52 within cylinder 49 is connected to piston rod 53. Hydraulic fluid is admitted to and exhausted from driving cylinder 49 through hoses (not shown) and couplings 131 and 132 to cause extension and retraction of piston rod 53, which in turn causes pivoting of driving arm 37. Piston rod 53 is connected at its outer end by bolt 55 between flanged portions 56a and 56b of support member 56 which is joined by welding or other suitable means to driving arm 37.

Roll, Extend and Clamp Mechanisms

Referring now to FIGS. 3, 8 and 9 the extractor head assembly H includes the roll assembly 62 which, in turn, includes the extend mechanism 68 and the clamp mechanism 64. Roll assembly 62 is connected to extractor head support housing 60 by means of bolts 133 and 134 that extend through flanges in the support housing 60 and in the roll assembly 62 as indicated at 135. Roll down of the roll assembly 62 is controlled by a roll mechanism including a roll cylinder 136 and a safety uplock assembly 137. Hydraulic fluid is introduced to one or the other end of cylinder 135 to drive a piston 138 in one or the other direction and position the roll assembly up or down. Piston 138 is connected to a piston rod 139 which is connected to a clevis 141 on the roll assembly.

Roll assembly 62 is held in the normal or upright position by means of safety uplock assembly 137. The safety uplock assembly includes a piston 147 that is biased by a spring 148 downwardly against the head of a pin 150 that projects into an opening in the housing of the roll assembly. When it is desired to release the roll assembly and cause it to roll down, hydraulic fluid is supplied to uplock assembly 137 to urge pin 150 upwardly against the bias of spring 148 and lift it out of engagement with the roll assembly. At the same time, hydraulic fluid is exhausted from the lower side of piston 138 in roll cylinder 135 and the roll assembly is rotated in a controlled fashion to the position shown in FIG. 3, but with the clamping mechanism 64 not extended.

To return the roll assembly to its upright position, hydraulic fluid is supplied to the lower side of piston 138 and causes piston rod 139 to pull clevis 131 upwardly and pivot the roll assembly 62 about the bolts 133 and 134 to return it to its upright position. The roll assembly is locked in the upright position, as described above by uplock assembly 137. A normally open limit switch 152 is held closed when the roll assembly is in the upright position. The function of this limit switch will be discussed below.

The extend mechanism 68 includes a rotary hydraulic actuator 154 which drives a shaft 155 in response to the introduction of hydraulic fluid. Shaft 155 is connected to and rotates a crank arm 157 the outer end of which is pivotally connected as shown at 158 to a driving arm 160. Rotation of shaft 155 is converted by crank arm 157 and pivotal connection 158 to linear motion of driving arm 160. A normally open limit switch 161 is held closed by contact between driving arm 160 and an actuator arm 162 of the limit switch when the extend mechanism is in the retracted position shown in FIGS. 8 and 9. When the extend mechanism is in its extended position driving arm 160 is swung in the direction of the arrow A in FIG. 8 and actuator arm 162 of limit switch 161 is allowed to pivot in the direc-

tion of the arrow B to open the limit switch contacts. The function of switch 161 will be described below.

Driving arm 160 is connected by means of a connecting rod 165 to a clevis assembly 166 which in turn is connected to a slide bar 168. As seen in FIGS. 3 and 8 a pivot arm 170 is pivotally connected to slide bar 168 by a pivot pin 171. Pivot arm 170 is connected at its other end to a clamp cylinder 173 which controls the clamping and unclamping of the jaws 65. An extension fulcrum 175 is pivotally connected to the forward end of slide bar 168 by a pivot pin 176 and is also connected to a clamp arm 178. A pivot link 180 is pivotally connected at one end to the housing of the roll assembly 62 and is pivotally connected at its other end to approximately the midpoint of extension fulcrum 175.

In operation, as hydraulic fluid is introduced to rotary actuator 154 crank arm 157 is caused to rotate in the direction of the arrow A in FIG. 8 which causes driving arm 160 to drive slide bar 168 forward to the position shown in FIG. 3. The forward motion of slide bar 168 causes pivot arm 170 and extension fulcrum 175 to pivot about pins 171 and 176 and extend clamp cylinder 173 and clamp arms 178 transversely of the direction of motion of slide bar 168. The clamp mechanism, including clamp cylinder 173, clamp arms 178 and clamp jaws 65, thereby assumes the extended position shown in FIG. 3. Admission of hydraulic fluid to rotary cylinder 154 to cause shaft 155 to rotate in the opposite direction causes retraction of the clamping mechanism to the position shown in FIG. 8.

Clamping mechanism 64 includes clamping cylinder 173 which houses a piston 182 connected to a piston rod 183. Piston rod 183 is pivotally connected to the common end of a pair of scissors links 184 and 185 which are pivotally connected at their opposite ends to clamp arms 178. Clamping jaws 65 are connected to the ends of clamp arms 178. In operation, jaws 65 are opened and closed by admitting hydraulic fluid to one or the other side of piston 182 to cause piston rod 183 to open and close scissor links 184 and 185 and thereby open and close clamp jaws 65.

A manifold 188 is mounted toward the rear of the housing of roll assembly 62 and provides hydraulic fluid to clamp cylinder 173 and rotary cylinder 154. Hoses and related couplings by which hydraulic fluid is supplied to roll cylinder 135, rotary cylinder 154 and clamp cylinder 173 have not been shown since a suitable position for them will be obvious to those skilled in the art.

Hydraulic Circuits

Referring now to FIGS. 10 and 10a and initially to FIG. 10 hydraulic fluid is supplied to the various actuating cylinders from a hydraulic reservoir 190. Fluid is pumped from the reservoir by means of a pump 191 driven by a motor 192 and is passed through a strainer 193. Fluid is supplied to and exhausted from clamp cylinder 173, rotary cylinder 154, roll cylinder 136 and driving cylinder 49 through supply line 195 and return line 196. Fluid is supplied to one or the other end of clamp piston 182 in accordance with the position of a spring biased solenoid operated control valve 198 through manifold 188 and to one or the other end of rotary cylinder 154 through manifold 188 in accordance with the position of an identical valve 199. Identical valves 201 and 202 control the passage of hydraulic fluid to one or the other side of roll piston 138 and drive piston 52. Hydraulic fluid is also supplied to up-

lock assembly 137 through valve 201 to release roll assembly 62 in the manner described above. Hydraulic fluid is returned to reservoir 190 through a filter 204.

Referring now to FIG. 10A the spray-blow assembly is supplied with air for the spray nozzles 80 and for the blow tube 76 from a supply indicated generally at 206. High pressure air for the blow tube 76 is supplied through a spring biased solenoid operated valve 208 and manifold 73 to the blow tube 76. Air for the spray nozzles 80 is supplied through a valve 210 identical to valve 208 and through manifold 73 to nozzles 80. Air from source 206 is also supplied through a shut-off valve 212 and a check valve 213 to a stand pipe 215 to pressurize spray liquid in a tank 216. The liquid to be sprayed is supplied from the tank 216 and directed to spray nozzles 80 through a spring biased solenoid controlled valve 218 and manifold 73. Pressure regulators (not shown) may be provided to regulate the pressure of the spray air and liquid supplied to the nozzles 80.

The means and the manner in which the solenoid operated valves are actuated to supply hydraulic fluid to the various actuating cylinders and to control the operation of the spray-blow assembly is described below.

Electrical Control Circuit

FIG. 11 is a diagram of the electrical control circuit for the article extractor when arranged to operate in synchronism with a die casting machine 10 to carry out all of the steps described above.

Power lines 219 and 220 are connected to a source of power (not shown) and conduct power through a circuit breaker 221 and an on-off switch 222 to the various switches, relays and timing relays and the solenoids of the solenoid controlled valves that comprise the control circuit. An indicating lamp 223 is connected across lines 219 and 220 to indicate when power is being supplied thereto.

The control circuit includes relays 225, 226, 227 and 228. Relay 225 is provided with normally open contacts 225a. Relay 226 is provided with normally open contacts 226a and 226b. Relay 227 is provided with normally closed contacts 227a and normally open contacts 227b. Relay 228 is provided with normally open contacts 228a and 228b. Relay 229 is provided with normally open contacts 229a.

The circuit also includes timing relays 232 to 236. Timing relay 232 is provided with normally closed contacts 232a and normally open contacts 232b and 232c. Timing relay 233 is provided with normally closed contacts 233a and 233b and with normally open contacts 233c. Timing relay 234 is provided with normally closed contacts 234a. Timing relay 235 is provided with normally open contacts 235a and 235b, and timing relay 236 is provided with normally closed contacts 236a.

Also in the control circuit are the solenoid coil 202s for valve 202 that controls the introduction of hydraulic fluid to drive cylinder 49, solenoid coil 199s for valve 199 that controls the extend mechanism, solenoid coil 198s for valve 198 which controls the clamp cylinder and solenoid coil 201s for valve 201 which controls the roll cylinder. Contacts 95a and 95b of limit switch 95 (FIG. 1) are also in the control circuit as are contacts 152a and 152b of limit switch 142 (FIG. 9) and contacts 161a and 161b of limit switch 161 (FIG. 9). Sensor probes 92 (FIG. 4) are also included in the circuit and are shown diagrammatically at 92a.

Finally, the circuit includes a start pushbutton switch 240 and a cycle-start switch 242 wired across start-switch 240. Switch 242 is a normally open switch mounted on the die casting machine and momentarily closed just before the platens 12 and 13 reach their full open position. Switch 242 allows the article extractor to automatically start a new extraction cycle without depressing of start pushbutton 240. Another switch 244 connected in series with the parallel combination of switches 240 and 242 is also mounted on the die casting machine and is normally open but held closed when the platens 12 and 13 are fully open.

The control circuit of FIG. 11 is shown as when the extractor is in its rest position retracted out of the die area with power off. When power switch 222 is closed indicating lamp 223 is lit and relay 225 is energized through contact 95a of limit switch 95. Operation of the article extractor is initiated by momentarily depressing start push button 240. If switch 244 is closed indicating that platens 12 and 13 are fully open, if contacts 161a are closed indicating that the clamp mechanism is retracted and if contacts 152a are closed indicating that the roll assembly is up, then relay 226 is energized through normally closed contacts 227. Contacts 226a are thereby closed and provide a path to maintain relay 226 energized after start pushbutton 240 is released. Contact 226a also provides a path to energize solenoid coil 202s through contact 152b which is closed if the roll assembly is in the up position. Energization of solenoid coil 202s causes hydraulic fluid to be supplied to drive cylinder 49 to extend the extractor head assembly into the die area.

When the extractor head assembly is extended fully into the die area limit switch 95 is switched by the cam 94 as shown in FIG. 1 which closes contact 95b and allows solenoid coil 199s to be energized. The clamping mechanism is thereby caused to extend toward the casting as shown in FIG. 2. Simultaneously with the energization of solenoid coil 199s, timing relay 232 is energized but is a slow operate relay and provides a predetermined delay to allow the clamping jaws to be positioned properly with respect to the casting to be extracted. At the end of that delay contact 232a opens to de-energize solenoid coil 199s and contacts 232b and 232c close. Timing relay 232 is maintained energized through contacts 232b and 234a and solenoid coil 198s is energized through contact 232c to cause the clamping jaws to be closed upon the casting. At the same time, contact 232a is opened deenergizing solenoid coil 199s and switching valve 199 (FIG. 10) to the position where the clamping mechanism is caused to be retracted with the clamping jaws grasping the casting.

As the clamping mechanism becomes completely retracted limit switch 161 (FIGS. 8 and 9) is operated and contacts 161a and 161b which were open are again closed and contact 161b provides a path for relay 227 to be energized.

Operation of relay 227 opens contacts 227a deenergizing relay 226 which in turn opens contacts 226a and deenergizes solenoid coil 202s. As a result, drive cylinder 49 is caused to retract extractor head assembly H out of the die area. Simultaneously with the retracting motion of the extractor head assembly sensor probes 92 are sensing for completeness of the casting held by the clamping jaws. If the casting is complete and so sensed by one sensor probes the circuit is com-

pleted as indicated at 92a and a path is provided to energize relay 229 which closes contacts 229a.

Energizing of relay 227 also closes contacts 227b and provides a current path to slow-operate timing relay 235. After a predetermined delay timing relay 235 operates and closes contacts 235a and 235b to provide a current path to slow operate timing relay 236. Closing of contact 235a also provides a current path through normally closed contact 236a to solenoid coils 210s, 208s and 218s which control the supply of spray air, blow air and liquid to the spray-blow assembly. The spraying and blowing occurs during the operate time of timing relay 236 and when timing relay 236 is operated contact 236a is opened to deenergize solenoids 210s, 218s, and 208s and terminate the spraying and blowing operation.

When the extractor head assembly H is completely retracted out of the die area limit switch 95 is operated by cam 94, closing contacts 95a and energizing relay 225. Energization of relay 225 closes contacts 225a and provides a path through contacts 232c, contacts 229a and contacts 225a to energize relay 228 and, after an operate delay, slow operate timing relay 233. Solenoid coil 201s is also energized through contacts 233b and causes the roll assembly to roll down as described above. Operation of relay 228 closes contacts 228a and allows solenoid coil 199s to be energized and cause the clamping mechanism to be extended. After a predetermined delay timing relay 233 operates and opens contacts 233a and 233b and closes contacts 233c. Opening of contacts 233a deenergizes solenoid coil 198s and causes clamping jaws to open and release the casting. Relay 227 is also deenergized by opening of contacts 233a so that contacts 227b open and deenergize timing relays 235 and 236.

Opening of contacts 233b causes deenergization of solenoid coil 201s which causes the roll assembly to be returned to its original position. At the same time, closing of contacts 233c provides a path for energizing slow operate timing relay 234. After a predetermined time, timing relay 234 operates and opens contacts 234a which releases timing relay 232 thereby opening contacts 232c. This in turn causes deenergization of relay 228 and opening of contacts 228a to deenergize solenoid coil 199s and cause the clamping mechanism to be retracted to its original position.

A full extractor cycle has now been completed and the extractor and its control circuit are once again in their initial position awaiting a signal to start another extraction cycle. During this waiting period the die casting machine 10 is operating through a forming cycle. When the die platens 12 and 13 are again opened, limit switches 242 and 244 will be operated and another extractor cycle will be initiated. Operation may continue automatically in this manner until the desired number of articles have been formed and extracted.

While a preferred form of this invention has been disclosed herein, it will be apparent to those skilled in the art that changes and improvements may be made in the form specifically disclosed without departing from the scope and spirit of the invention. Accordingly, this invention is not to be limited to the specific form disclosed herein nor in any other way inconsistent with the progress in the art promoted thereby.

What is claimed is:

1. Apparatus for extracting formed articles from an article forming machine comprising

a body adapted to be mounted on said article forming machine,
 a driving arm and an idling arm pivotally connected to said body at spaced locations thereon,
 an extractor head adapted for linear movement into and out of said article forming machine to extract formed articles therefrom,
 a support arm and a stabilizer arm pivotally connected to said extractor head at spaced locations thereon,
 means pivotally connecting together said driving arm, idling arm, support arm and stabilizer arm, and
 driving means for causing said driving arm to pivot with respect to said body
 said connecting means causing pivotal movement of said driving arm to be converted to linear movement of said extractor head,
 whereby said extractor head is caused to move linearly into and out of said article forming machine to extract formed articles therefrom.

2. Apparatus as claimed in claim 1 wherein said connecting means includes a pivot link integrally connected to said support arm and pivotally connected at one end to said driving arm and at its other end to said idling arm.

3. Apparatus as claimed in claim 2 including a pair of idling arms and a pair of pivot links, each of said idling arms being pivotally connected to said body and each of said pivot links being integrally connected to said support arm and pivotally connected at one end to said driving arm and at its other end to one of said idling arms.

4. Apparatus as claimed in claim 1 wherein said driving means includes a cylinder and a piston reciprocable within said cylinder, retraction and extension of said piston causing pivotal movement of said driving arm.

5. Apparatus as claimed in claim 1 wherein said extractor head includes article clamping means and means for laterally extending and retracting said article clamping means to enable it to clamp a formed article and remove it from the article forming means of said article forming machine.

6. Apparatus as claimed in claim 1 wherein said extractor head includes a roll assembly, article clamping means on said roll assembly and means for rotating said roll assembly to and from an upright position in a vertical plane enabling said clamping means to clamp a formed article in said article forming machine from and to a position in a horizontal plane enabling said formed article to fall freely when released by said clamping means.

7. Apparatus as claimed in claim 1 further comprising a boom carried by said extractor head and extending outwardly therefrom toward said article forming machine, spraying means carried by said boom and means for causing said spraying means to spray fluid on the article forming areas of said article forming machine as said extractor head is retracted out of said article forming machine.

8. Apparatus for extracting formed articles from an article forming machine having article forming members movable with respect to each other to form an article therebetween comprising a body adapted to be mounted on said article forming machine to extend transversely thereof, a driving arm and an idling arm having their one ends pivotally connected to said body

at spaced locations thereon and extending transversely of the direction of movement of said article forming members, extractor means movable linearly into and out of the path of movement of said article forming members to extract a formed article from one of said article forming members when said members are separated, a support arm and a stabilizer arm pivotally connected to said extractor means at spaced locations thereon, a pivot link integrally connected to said support arm and pivotally connected at one end to said driving arm and at its other end to said idling arm, means pivotally connecting said stabilizer arm to said idling arm, and driving means for causing said driving arm to pivot with respect to said body, whereby said extractor means is caused to move linearly into and out of the path of movement of said article forming members to extract a formed article from said article forming machine.

9. In combination, an article forming machine and apparatus for extracting articles therefrom, said article forming machine having article forming members movable with respect to each other to form an article therebetween and having tie bars extending parallel to the direction of movement of said members, said extracting apparatus including a body mounted on said tie bars and extending transversely thereof, a driving arm and an idling arm pivotally connected to said body at spaced locations thereon and extending transversely of the direction of movement of said article forming members, an extractor head movable linearly into and out of the path of movement of said article forming members to extract a formed article from one of said article forming members when said members are separated, a support arm and a stabilizer arm pivotally connected to said extractor head at spaced locations thereon, means pivotally connecting together said driving arm, idling arm, support arm and stabilizer arm, and driving means for causing said driving arm to pivot with respect to said body, said connecting means causing pivotal movement of said driving arm to be converted to linear movement of said extractor head, whereby said extractor head is caused to move linearly into and out of said article forming machine to extract formed articles therefrom.

10. Apparatus for extracting formed articles from an article forming machine comprising a body adapted to be mounted on said article forming machine, an extractor head adapted for linear movement into and out of said article forming machine to extract formed articles therefrom, a pivotal arm arrangement connected between said body and said extractor head for moving said extractor head into and out of said article forming machine to enable it to extract formed articles therefrom, said extractor head including a support housing and a roll assembly pivotally connected thereto, article clamping means on said roll assembly, and said support housing including means for rotating said roll assembly to and from a position enabling said clamping means to clamp a formed article in said article forming machine from and to a position enabling said formed article to fall freely when released by said clamping means.

11. Apparatus for extracting formed articles from an article forming machine comprising a body adapted to be mounted on said article forming machine, an extractor head adapted for linear movement into and out of said article forming machine to extract formed articles therefrom, a pivotal arm arrangement connected be-

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tween said body and said extractor head for moving said extractor head into and out of said article forming machine to enable it to extract formed articles therefrom, article clamping means carried by said extractor head, means for laterally extending and retracting said clamping means transversely of the direction of movement of said extractor head including a crank arm, means for rotating said crank arm, a driving arm pivotally connected to said crank arm to be moved linearly in response to rotation of said crank arm, a slide bar connected to said driving arm, a pivot arm pivotally connected at one end to said slide bar and at its other end to said clamping means, an extension fulcrum pivotally connected at one end to said slide bar and at its other end to said clamping means and a pivot link pivotally connected between said extension fulcrum and said extractor head, said extension fulcrum, pivot link and pivot arm extending and retracting said clamping means transversely of the direction of movement of said slide bar, and means for operating said clamping means to cause it to grasp a formed article.

12. Apparatus for extracting formed articles from an article forming machine comprising a body adapted to be mounted on said article forming machine, an extrac-

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tor head adapted for linear movement into and out of said article forming machine to extract to formed articles therefrom, a pivotal arm arrangement connected between said body and said extractor head for moving said extractor head into and out of said article forming machine to enable it to extract formed articles therefrom, a roll assembly on said extractor head, article clamping means on said roll assembly, said roll assembly including a housing pivotally connected to said extractor head and retaining means for retaining said roll assembly in upright position, means for rotating said roll assembly to and from a position enabling said clamping means to clamp a formed article in said article forming machine from and to a position enabling said formed article to fall freely when released by said clamping means, said means for rotating said roll assembly including a cylinder, a piston reciprocable within said cylinder and pivotally connected to said roll assembly and hydraulic means for releasing said retaining means and extending said piston to cause said roll assembly to roll to a position substantially at right angles to its upright position.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,765,474 Dated October 16, 1973

Inventor(s) Charles A. Burton

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 10, line 64, change "limit switch 142" to
--limit switch 152--.
Column 11, line 27, change "contaCt" to --contact--,
Column 11, last line, change "one" to --the--.
Column 16, line 2 (Claim 12) delete "to" (second occurrence)

Signed and sealed this 12th day of February 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents