Oct. 18, 1966 R. M. LELIAERT 3,279,125

MACHINE FOR CONTROLLED FREEZING, DEFLASHING AND TRIMMING OF PARTS

Filed May 12, 1964 3 Sheets-Sheet 1

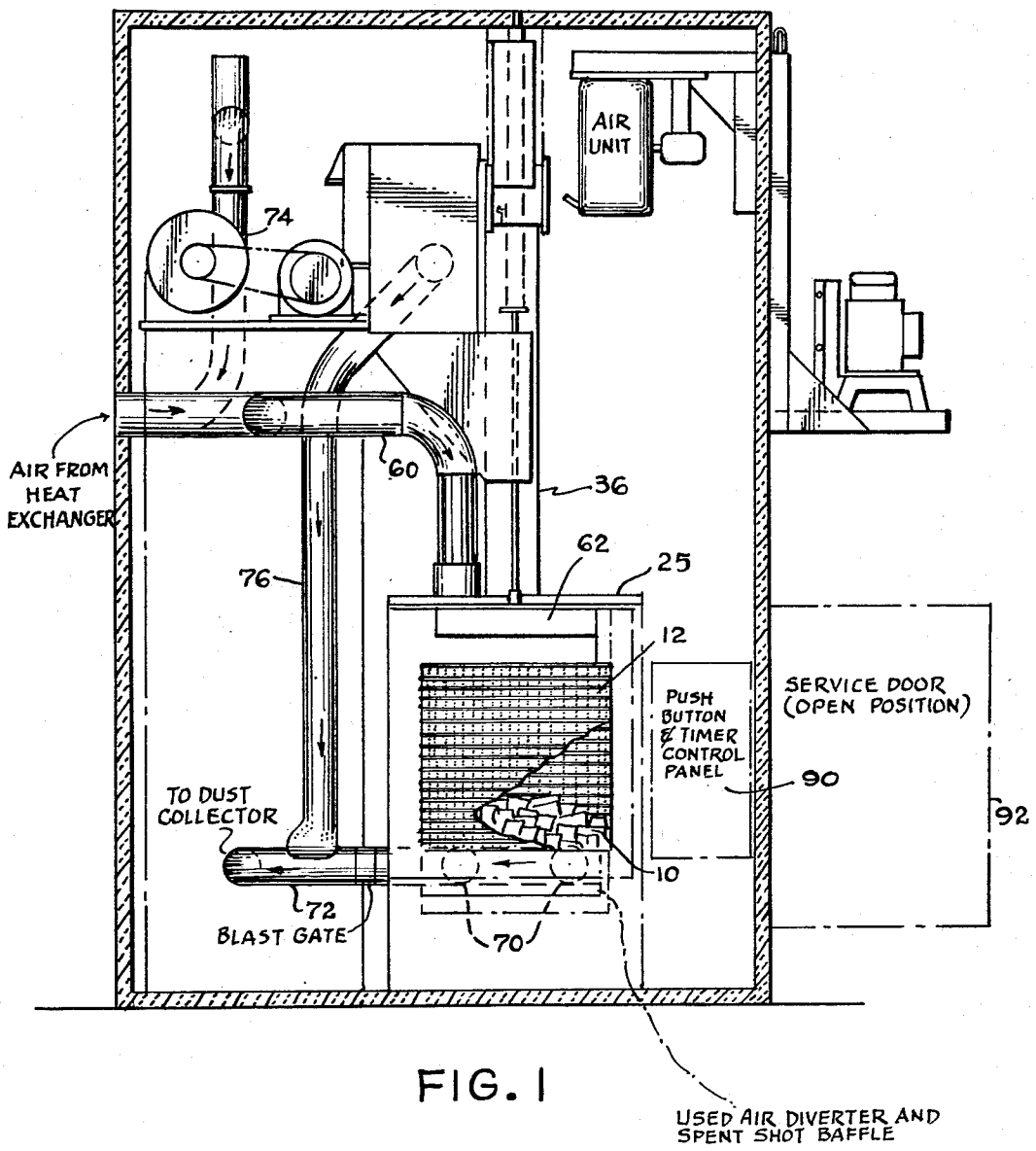

FIG. 1

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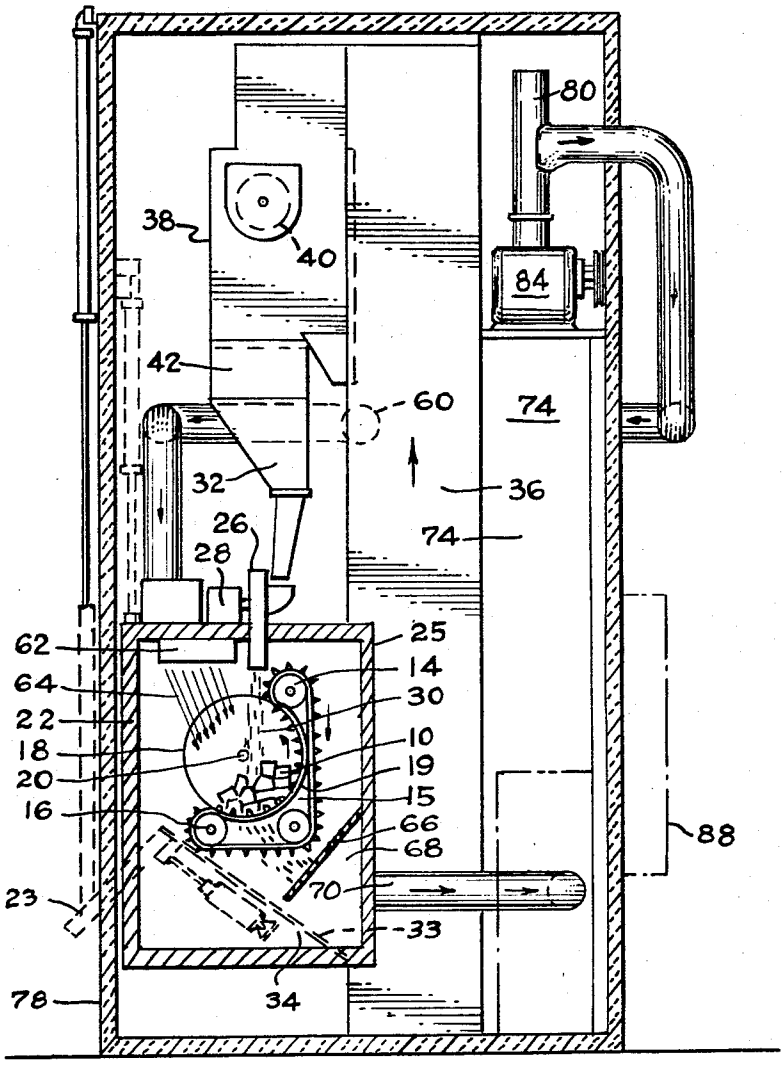

FIG. 2

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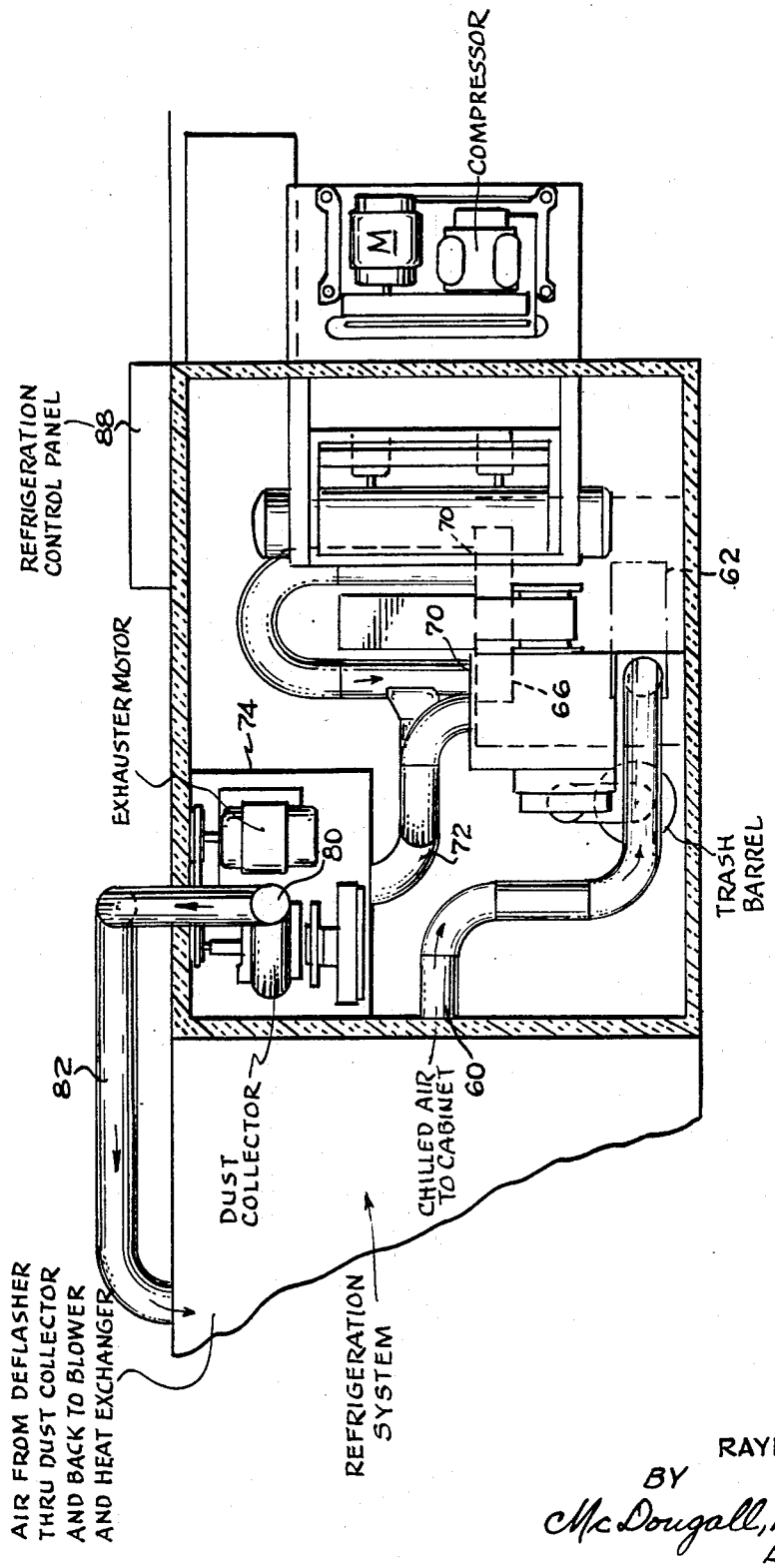

FIG. 3

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United States Patent Office 3,279,125 Patented Oct. 18, 1966

3,279,125

MACHINE FOR CONTROLLED FREEZING, DEFLASHING AND TRIMMING OF PARTS

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Filed May 12, 1964, Ser. No. 366,755
11 Claims. (Cl. 51—13)

This invention relates to the removal of thin fins, burrs and flashings from parts molded of rubber, plastics, metal and the like materials which are capable of embrittlement or are changed in physical properties in response to reduction in temperature and it relates more particularly to and means for the reduction in temperature to freeze fins and flashings of thin cross-section formed on molded or other parts to effect embrittlement and the removal of the embrittled fins or flashings by engagement with an impact or blast of particulate material.

In my previously issued Patent No. 2,996,846, description is made of a method and means for the removal of thin fins and flashings of molded rubber parts by blasting the parts with particulate materials after the parts have been exposed to a cold refrigerant fluid to cause freezing of the fins and flashings of thin cross-section whereby such frozen parts become embrittled to permit easy and complete removal in response to impact by the particles blasted against the surfaces of the parts as they are tumbled in a housing.

This invention is addressed to an improvement in the means described in my previously issued patent and it is an object of this invention to provide a means for achieving same.

More specifically, it is an object of this invention to provide an apparatus for the efficient and effective removal of fins and flashings and other thin sections projecting from the surfaces of molded and fabricated parts and it is a related object to provide a means of the type described in which more efficient utilization is made of the refrigeration materially to reduce the refrigeration required for the removal of fins, flashings, and such thin cross-sections and to provide improved finished parts, and which makes more effective utilization of the refrigeration to enable use of refrigerated air or other gas or fluid for the controlled freezing of the parts and to enable better distribution of the refrigeration thereby more effectively to cool the parts for better coverage and more complete freezing of the portions to be removed.

Another object is to provide a means of the type described in which the flow of the refrigerated air or fluid through the machine is intended to achieve a more complete coverage of the part and more uniform distribution of the cold through the working area of the machine; which provides for substantial separation of the cold fluid or aid from the particulate materials with which the parts are blasted thereby to enable recycle of the cold air or fluid for the recovery of cold invested in refrigeration; which recycles cold air or fluid not only from the working area but also from the surrounding environment thereby to enable refrigeration of the surrounding environment for more effective refrigeration of the parts, and which makes available refrigerated air for use in the mechanical abrasive blast of the parts thereby to avoid interference with the embrittlement of the parts.

These and other objects and advantages of this invention will hereinafter appear and for purposes of illustration, but not of limitation, an embodiment of the invention is shown in the accompanying drawings, in which—

FIG. 1 is a schematic elevational view from the front side of a machine embodying the features of this invention;

FIG. 2 is a schematic elevational view of the machine shown in FIG. 1 as viewed from the side; and

FIG. 3 is a schematic view of the machine shown in FIGS. 1 and 2 but in plan view from the top side.

The invention will be described with reference to the use of air as refrigerated fluid or gas cycled in heat exchange relationship with a liquid refrigerant whereby the temperature of the refrigerated gas can be adjusted depending upon the amount of refrigerant passed in heat exchange relationship with the gas and the amount and proportion of the gas passed in heat exchange relationship with the refrigerant to provide flexibility in the temperature and in the operating conditions of the refrigerated gas circulated through the machine. It will be understood that, instead of air, other gases or fluids may be passed in heat exchange relationship with the refrigerant liquid to provide the refrigeration which is circulated to the processing machine. While the supply of refrigerant gas does not constitute a part of the invention, reference can be made to my copending application filed concurrently herewith and entitled "Refrigeration System for Cold Vapor Blast" for a fuller description of the means for the supply of refrigerated gas to the machine and the recycle of spent cold gases from the machine to the refrigeration cycle.

As described in the aforementioned issued patent, the machine operates more or less on a batch principle in which the parts **10** to be treated are loaded into the machine for support on an endless apron type conveyor **12** which is in the form of an endless belt trained around pulleys or rollers **14** and **16** and a driving pulley or sprocket **15**. The endless belt is so arranged that the upper strand of the conveyor device trains under and behind a pair of barrel heads **18** which are carried on shafts **20**. Thus, as the barrel heads rotate, the endless belt **12** is guided thereby in its travel, causing it to assume a pocket type formation **19** into which the work-pieces **10** are cradled. For a fuller description of the conveyor, reference may be made to U.S. Patent No. 1,567,077, No. 1,882,443, and No. 2,104,055. It will be understood that any other suitable type of conveyor may be used instead of the one described.

A movable door **22** is provided through which consecutive batches of parts and workpieces may be loaded into the deflashing chamber and unloaded therefrom for delivery onto an unloading chute **23**. In normal operation, the conveyor **12** is driven so that the top strand portion thereof moves continuously inwardly and upwardly towards the pulley **14**. In operation, the workpieces are continuously drawn by the conveyor inwardly and upwardly with the conveyor until such time as they gently turn over and away from the vertical climb portion. The conveyor is preferably provided with cleats to facilitate displacement and turning over of the workpieces during operation of the conveyor. An unloading chute **23** is provided to receive the finished pieces when a batch deflashing operation is completed and the conveyor is reversed in its direction of operation to displace the workpieces forwardly off of the end of the conveyor for passage through the open door onto the chute.

More specifically, the construction of the conveyor **12** may be of any preferred form, but by way of an example, it may comprise a specially compounded abrasive-resistant rubber or plastic material characterized to remain flexible under sub-zero temperature conditions to which it may be exposed. Instead, it may be in the form of an apron type conveyor comprising articulated slats or aprons formed of metal or the like. The conveyor device is enclosed within a housing **25** which conveniently mounts one or more abrasive media projecting machines **26**. The abrasive blast projecting machines may be of any suitable type, such for example as the machine disclosed in Patent No. 2,708,814.

In any event, the blast machine or machines **26** will

be power driven, as by a motor **28**, and arranged to direct, preferably by centrifugal wheel blast technique, streams or patterns of steel shot or other abrasive material directly downwardly into the housing **25** between the barrel heads **18** so as to strike against the workpieces **10** which are cradled in the conveyor device. As shown in FIG. 2, the blast machine or machines **26** will be arranged to throw the blast media against the workpieces in the form of patterns or streams, as indicated by the numeral **30**. The blast machines **26** are arranged to be supplied continuously with blast media as through an abrasive storage hopper **42**, and it will be understood that more than one blast machine may be employed for the purpose of directing additional streams of blast material for more complete coverage of the workpieces.

An abrasive valve **32** is provided between the storage hopper **42** and the feed funnel of the blast machine **26**. This valve preferably is sealed from the surrounding atmosphere to prevent or minimize entrainment of relatively warm air from the insulated enclosure **78** into the centrifugal blasting wheel by its pumping action and said wheel projecting this warmer air onto the workpieces **10**. This sealing is particularly important when materials such as organo-silicon parts are being deflashed. Because of their very low embrittlement temperatures, extremely cold air from the refrigeration system is needed to be directed at the workpieces and any warmer air entering the abrasive blasting chamber through the centrifugal blasting wheel can only be a deterent to best operation. The seal around abrasive valve **32** may be fabricated of rubber sheet having a low embrittlement temperature and fastened in an air tight manner or the seal may be fabricated of sheet metal using practices common to this art.

The workpiece support conveyor **12** is of perforate form to permit passage therethrough of spent pellets or abrasive, the spent cold air used to refrigerate the parts, and small particles of fine or flashings which have been detached from the workpieces during treatment in the device. For this purpose, the conveyor may be formed with drain holes therethrough or may be otherwise constructed in a preferred manner so as to provide openings through which the spent abrasive, smaller refuse and spent air may escape downwardly onto machine hopper wall **33** over hopper **34** and adjacent to an inlet portion of an elevator **36** which delivers the mixture of refuse, abrasive media and the like to a separator, indicated by the numeral **38**.

The separator mechanism may be of any preferred form and may include a rotary screen **40** and/or an air wash separator. In any event, the separator **38** will be arranged so as to discharge the waste of the feed mixture including non-reusable portions of abrasive media and the removed fins and flash particles. Reusable abrasive is fed by gravity into the abrasive storage hopper **42** which feeds the blast machines **26**, through a specially sealed abrasive valve **32**, as previously described.

Having briefly described the mechanical elements of the machine, reference will now be made to the path of travel of the refrigerated air through the machine to effect freezing for embrittlement of portions of the workpieces of thin cross-section, such as the fins, flashings, etc. and wherein the parts are molded or otherwise fabricated of rubbers or other elastomers, plastics, metals and the like materials which are embrittled by the cold or changed in physical properties in response to reductions in temperature. It will be understood that some materials are embrittled by cooling to temperatures such for example as within the range of 0° F. to about —40° F., while others such as are formed of organo silicon resinous materials or elastomers are embrittled only at very low temperatures, such as at temperatures below about —90° F. to —180° F.

The cold air from the heat exchanger enters the machine through the inlet passage **60** for flow through the passage into the housing **25** to a distributor **62** positioned within the housing to extend crosswise and lengthwise thereof above the conveyor and forwardly thereof with nozzles angled to direct the cold air streams **64** angularly downwardly onto the surface of the conveyor in more or less uniform distribution across the area in which the workpiece **10** to be treated are cradled. The distributor **62** functions as a plenum chamber suspended from the top wall of the housing but preferably insulated therefrom with the outlet openings or nozzles uniformly distributed across the bottom wall of the distributor for the distribution of the cold air as streams from the bottom side thereof.

In order to insure uniform distribution of the cold air for flow through the bed of parts being tumbled over the moving conveyor system for fuller exposure of the parts to the blast particles simultaneously with exposure to the cold, the interior of the housing **25** is also provided with a baffle plate **66** which is secured to the backside of the housing in the region beyond and below the underside of the conveyor to extend angularly downwardly and forwardly across the housing from a line which corresponds to about the lower level of the conveyor forwardly to a line below the conveyor but just short of the machine hopper wall **33** which extends across the bottom portion of the housing below the conveyor from the front wall angularly downwardly and rearwardly to the backside of the housing.

The baffle plate **66** is intended to prevent the refrigerated air projected onto the conveyor from the distributor **62** from flowing primarily towards the upper portion of the conveyor to pass therethrough by reason of its being relatively free of parts whereby insufficient utilization would be made of the refrigerated air introduced into the housing for the cooling of the workpieces. By reason of the inclined baffle plate **66** which obstructs free flow of the cold air through the portions of the conveyor offering lease resistance, the refrigerated air issuing from the nozzles of the distributor is caused to flow across and through the mass of workpieces being tumbled on the moving conveyor whereby portions of thin cross-section become substantially uniformly exposed to the refrigerated air for more rapid freezing and removal thereof thereby materially to shorten the treating cycle with corresponding savings in time, material, and refrigeration, and with fuller utilization of the machine time.

The inclined baffle plate **66** operates not only to divert the refrigerated air but it also functions in the manner of a separator to displace the spent shot and abrasive material forwardly over its surface to the underlying hopper wall **33** thereby to assist in the separation of the spent refrigerated air from the shot and from the abrasive materials or solids falling from the conveyor.

Thus the cold refrigerated air introduced from the nozzles of the distributor **62** follows a path through the conveyor belt and the workpieces supported thereon and then downwardly and forwardly about the lower end of the baffle plate **66** for continued flow rearwardly into the plenum chamber **68** defined by the baffle plate **66** to the outlets **70** located in the rear wall of the housing beneath the baffle plate for continuous separation of the spent refrigerated air from the solids. The spent refrigerated air passes from the housing through the outlet openings into the conduits **72** by which the spent refrigerated air is conducted laterally and then into the dust collector **74**.

Air flowing from the interior of the insulated enclosure **78** into the separator **38** to separate the refuse from reusable abrasive media is caused to flow through pipe **76** for joinder with the spent refrigerated air exhausted from the housing for travel together through the pipe **72** to the dust collector. Included with the spent refrigerated air exhausted from the housing **25** and cycled to the dust collector may be a relatively small amout of air.

taken from the insulated enclosure **78** by the centrifugal blast wheels **26** and introduced into the housing with the shot or abrasive particles. In order to replace any such air removed by the centrifugal wheels from the enclosure **78**, and in order to help maintain the temperature of the enclosure in a refrigerated state, a corresponding amount of spent refrigerated air is released into the enclosure **78** through the conduit **80** to the blower by which the air is withdrawn for travel through the refrigeration system in heat exchange relationship with liquid refrigerant to recool the air before return through line **60** to the distributor **62** in the housing. Also to maintain the temperature of the air in the enclosure **78** in a refrigerated state so that only dry air of low dew point is introduced into housing **25**, a mechanical refrigeration unit **94** is employed to cool said air. Control panel **88** controls the refrigeration and defrost cycles of the mechanical refrigeration unit **94**. The dust collector is belt driven by an electrical motor **84**.

Mounted on the exterior of the enclosure is a control panel **90** which is a control center for the refrigeration cycle, including the amount of refrigerant passed in heat exchange relationship with the recycled refrigerated air, the proportion of refrigerated gas bypassing the heat exchangers and other controls in air movement, all in response to temperature controllers within the housing and the temperature selected for operation on the particular type of material of which the workpieces are formed and which are to be processed in the machine. Panel **90** also is a control center for the deflashing machine operation including controlling the opening and closing of doors, turning on and off the centrifugal blasting wheels, varying the speed of the motors driving the blasting wheels, varying the amount of abrasive thrown by the wheels onto the workpieces and operating the conveyor and its speed of travel.

Control panel **90** is an integrated unit of timers, temperature sensor, amplifying and transmitting devices, indicating lights for display of operating functions, selector switches and push button stations for controlling and operating the refrigeration engine and other components of the refrigeration system and components of the deflashing machine in either manual or automatic programmed cycles. By way of example, it may include timers of the mechanical, pneumatic or solid state type and it may include temperature sensor-transmitter arrangements such as the pneumatic arrangements manufactured by the Foxboro Company which may use gas filled sensor bulbs which measure or compare temperatures and amplify signals to operate pneumatic or hydraulic motor valves, electrically operated motor valves or other appropriate control systems; or it may include temperature sensor-transmitter arrangements using thermocouples which produce an electrical signal which can be amplified and transmitted to operate motor control valves or other control devices on the refrigeration and deflashing machines.

To facilitate performance of the apparatus, the housing **25** is enclosed within a substantially airtight and thermally insulated enclosure **78**, cooled by mechanical refrigeration unit **94**, as previously described. Thus the housing **25**, the blast wheels **26**, the elevator **36**, the separator **38** and the dust collector **74** are all combined within the heat insulated enclosure **78** into which cold air is bled from the dust collector to maintain the enclosure in a balanced state of pressure. This serves to maintain sub-ambient temperatures in the area of the blast operation and operates to reduce the amount of refrigeration required by the heat exchanger.

It will be understood that suitable access doors, such as the service door **92** and loading and unloading door **22** will be provided for access to the interior of the enclosure and to the interior of the housing.

In use, the workpieces are loaded onto the conveyor **12** through the door **22** which is adapted for power operation between open and closed positions and which is adapted to be displaced in closed position to effect a sealing relations within the housing to minimize the loss of cold from within the housing. Aligned with the lower end of the door is the delivery chute **23** over which the workpieces are displaced for delivery from the housing when the conveyor is reversed to displace the workpieces forwardly to the door opening.

It will be apparent from the foregoing that I have provided improvements in a processing machine of the type described wherein more efficient utilization is made of refrigerated air in the blast cycle to effect freezing of thin sections of workpieces to enable easy removal thereof by blast, pellets, particles, or the like.

It will be understood that changes may be made in the details of construction, arrangement and operation without departing from the spirit of the invention, especially as defined in the following claims.

I claim:

1. In a machine for definning and deflashing parts comprising a housing, means for supporting the parts within said housing and for continuously tumbling the parts, means for projecting a stream of particulate material onto said parts in said housing, means for projecting a cold fluid into said housing into engagement with said parts for reducing the temperature of the parts to cause embrittlement of the thin fins and flashings whereby the embrittled fins and flashings are easily removed upon engagement by the stream of particulate materials, a dust collector having an inlet in communication with the housing for receiving spent cold fluid and entrained particulate material including particles of fins and flashings removed from said parts, and for separating said spent cold fluid from said particles, said dust collector having an outlet for return of separated spent cold fluid for re-refrigeration, and in which the means for projecting the stream of cold fluid into the housing comprises a distributor extending across the housing and having outlets for issuance of the cold fluid as a plurality of streams distributed across the housing and issuing in the direction of the parts.

2. A machine as claimed in claim **1** in which the distributor extends across an upper portion of the housing with the outlets in the lower portion thereof for the issuance of the cold fluid as a plurality of spaced apart streams distributed across the housing and directed downwardly onto the parts.

3. A machine as claimed in claim **2** in which the outlets are uniformly spaced in the distributor to extend across the housing.

4. In a machine for definning and deflashing parts comprising a housing, means for supporting the parts within said housing and for continuously tumbling the parts, means for projecting a stream of particulate material onto said parts in said housing, means for projecting a cold fluid into said housing into engagement with said parts for reducing the temperature of the parts to cause embrittlement of the thin fins and flashings whereby the embrittled fins and flashings are easily removed upon engagement by the stream of particulate materials, a dust collector having an inlet in communication with the housing for receiving spent cold fluid and entrained particulate material including particles of fins and flashings removed from said parts and for separating said spent cold fluid from said particles, said dust collector having an outlet for return of separated spent cold fluid for re-refrigeration, and a baffle plate within the housing beyond the parts and extending across the stream of the cold fluid introduced into the housing and confronting the inlet to the separator to prevent channelling of the stream of cold fluid and to effect preliminary separation between the spent cold fluid and particulate material as well as refuse in the form of fins and flashings removed from the parts.

5. A machine as claimed in claim **4** in which the baffle plate extends across the housing beyond and below the parts supported within the housing and positioned to

project angularly downwardly over the inlet to the separator.

6. A machine as claimed in claim 4 in which the baffle plate extends forwardly and downwardly from a wall of the housing opposite the wall adjacent the means for projecting the stream of cold fluid into the housing thereby to position the parts between the means for projecting the cold fluid into the housing and the inlet to the separator whereby the cold fluid is caused relatively uniformly to pass between the parts.

7. In a machine for the definning and deflashing of parts comprising a housing, means for supporting parts within said housing and continuously tumbling the parts to expose different surfaces, means for projecting a stream of particulate material onto said parts in said housing, means for projecting a stream of cold gas into said housing into engagement with said parts for reducing the temperature of the parts to cause embrittlement of the thin fins and flashings whereby the embrittled fins and flashings are easily removed responsive to engagement by the particulate material, said means including an inlet plenum chamber extending crosswise of the housing above the parts and having outlet openings in the lower portion of said plenum chamber for issuance of the streams of cold gas therefrom and in the direction towards said parts, a baffle plate within said housing positioned in the path of the stream of cold gas beyond said parts to prevent channeling of the cold gas streams so as more uniformly to engage said parts, a dust collector having an inlet communicating with the housing for the removal of spent cold gas and entrained particles from said housing for the separation thereof, said inlet being positioned in

said housing beyond the baffle plate whereby the baffle plate lies in the path of the travel of the cold gas through said housing.

8. A machine as claimed in claim 7 which includes means connecting the plenum chamber with a source of supply of cold gas and in which the dust collector has an outlet and means for recirculating the spent cold gas from the outlet to a refrigeration source for re-refrigeration thereof.

9. A machine as claimed in claim 7 which includes a chamber surrounding the housing and means for bleeding off cold gas into the chamber for refrigeration of the chamber whereby gas entrained with the particulate material projected into the housing comprises a refrigerated gas.

10. A machine as claimed in claim 9 in which the means for bleeding off cold gas into the chamber comprises means for bleeding off spent cold gas from the separator into the chamber.

11. A machine as claimed in claim 9 in which the means for bleeding off cold gas into the chamber comprises means for bleeding off refrigerated gas from the stream supplied to the plenum chamber.

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