Usage of automatic coolant spray unit on Die Casting Machine

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***Abstract*— A spray nozzle is a precision device that facilitates dispersion of liquid into a spray. Nozzles are used for three purposes: to distribute a liquid over an area, to increase liquid surface area, and create impact force on a solid surface. Spray nozzles can be categorized based on the energy input used to cause automization, the breakup of the fluid into drops. Spray nozzles can have one or more outlets; a multiple outlet nozzle is known as a compound nozzle. Spray nozzles range from heavy duty industrial uses to light duty sprays. Spray nozzles utilize the kinetic energy of the liquid to break it up into droplets. As the fluid pressure increases, the flow through the nozzle increases, and the drop size decreases.**

***Keywords*— Spray Nozzle, Automization, Orifice**

I. INTRODUCTION

The shaped orifice uses a semispherical shaped inlet and a *V* notched outlet to cause the flow to spread out on the axis of the V notch. Due to this converging part of the nozzle there is increase in pressure of the coolant while spraying which cools the surface area more quickly and effectively**.**

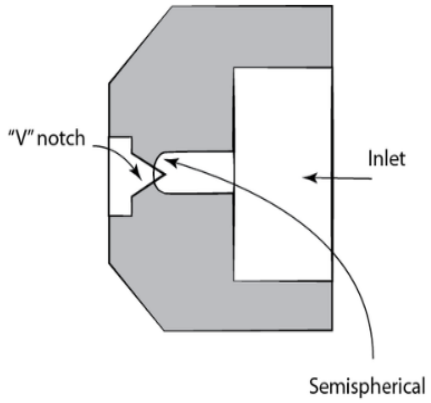

Fig 1:- ST-6 Spray gun

Air pressure used for spraying is 5 bar (72.5 psi) and the Liquid pressure is 2.06 bar (30 psi). Elimination of remaining pressure in the line must be done before attaching or detaching the spray gun because if it is not done then pressure will remain in the line and if directly supply is given then excess pressure will spill out the liquid and can cause injury to operator and can damage the equipments. 3 ports solenoid valve is mainly used in this coolant spray setup because it is used to release the secondary air in the atmosphere when the spray gun is stopped. If 2 port solenoid valves are used, the liquid flow will not stop because air will not be discharged completely into atmosphere.

No. of spray guns used	Piping fitting	Air consumption (L/min)	Effective sectional area (mm^2)
1	¼	46-76	3-5
2-3	3/8	92-228	4-15
4-6	3/8	184-456	10-25
7-10	½	322-760	15-40

Table 1:- Spray Specifications

Air can be used with low pressure of 0.01 Mpa, middle pressure of 0.1Mpa, high pressure of 0.4 Mpa. When spraying a fine mist air pressure should be set higher and when spraying a coarse mist set the pressure lower. When spraying an oil, low pressure air spraying at 0.01-0.1 Mpa can inhibit oil scattering.

A. Spray through pressurized liquid tank.

For spraying high viscosity liquid, a high quantity of liquid or when spraying the liquid from a position lower than the spray gun we generally use pressurized liquid tanks. Set the level of air pressure inside the pressure liquid tank up to 5 bar. The flow adjustment of liquid quantity become less stable if too high liquid pressure is applied. For this reason first the level of pressure inside the pressure liquid tank is set low as possible and then adjusts the quantity with the help of liquid volume adjuster.

B. Gravity Feed Container

For spraying low viscosity liquid and low quantity of liquid, the gravity feeder is used. This feeder is set at the higher position (0-200cm) than the spray gun. Greater the difference in elevation between the two, more the liquid quantity to be sprayed increases.

C. Spray Pattern Adjustment

The knob is used for adjusting the pattern of the spray according to the application. Turning the knob clockwise fully the pattern of spraying becomes round. By turning the knob anti clockwise the air is sprayed from 2 holes of fan pattern air cap horn portion and the round pattern gradually becomes fan pattern. Before the setting of the automatic coolant spray gun machine the coolant was sprayed on the die mechanically by the hand held coolant gun. One operator used to perform the operation of removing the rotor from die cavity and place those on cooling conveyor and then another operator used to spray coolant on the die and then apply grease. This mechanically operating of coolant consumed time to greater extent. On an average nearly about 15-20 seconds were required for manual spraying of coolant and for applying grease on the die extra 10 seconds were required

II. PROBLEM IDENTIFICATION

Fig 2:- Physically handled spray gun

1. Before the setting of the automatic coolant spray gun machine the coolant was sprayed on the die mechanically by the hand held coolant gun.
2. One operator used to perform the operation of removing the rotor from die cavity and place those on cooling conveyor and then the operator used to spray coolant on the die and then apply grease.

3. This mechanically operating of coolant consumed time to greater extent.
4. On an average nearly about 15-20 seconds were required for manual spraying of coolant and for applying grease on the die extra 10 seconds were required.

III. METHODOLOGY

The coolant spray gun was replaced by the coolant spray tray containing numerous individual spray. This coolant spray tray is operated pneumatically with the help of air. The time required for spraying coolant is also considerably less as compared to manual spraying. The speed flow of the coolant and the pattern of flow can be adjusted with the help of spray pattern adjuster. The time required for spraying coolant by automatic coolant spray gun on the die cavity is 10 seconds and the time required for applying grease is 5 seconds.

Fig 3:- Assembly of coolant spray unit

The coolant spray tary is driven up and down pneumatcally by the air. Pneumatic cylinder containing no piston inside it is used for movement of the coolant sprays. The cylinder moves up and down through the guideways provided on the outer side of the cylinder. This movement is highly efficient as the friction produced is les in the guideways. The speed of the coolant spray depends on the pressure of air, The cylinder reciprocates fast if the air pressure is more orelse it reciprocates slowly in case of less air pressure.

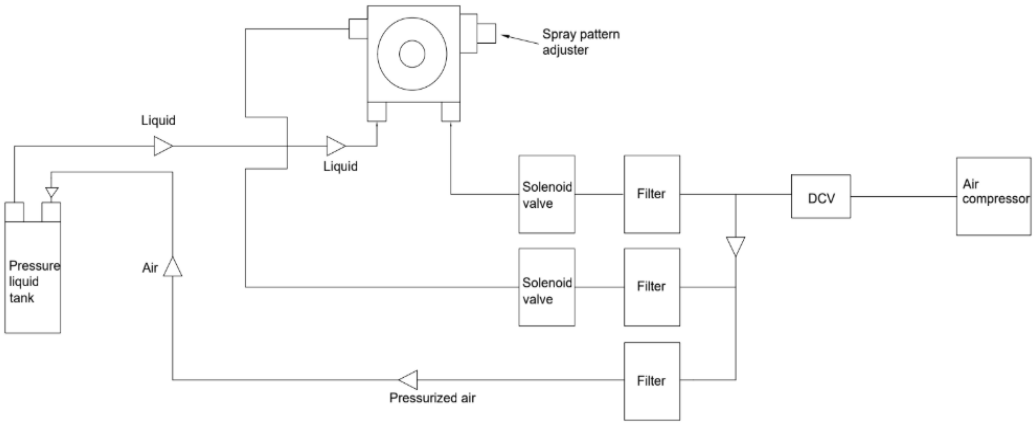

Fig 4:- Block diagram for coolant spray working.

The coolant pray unit consists of pressure liquid tank, spray gun, DCV, filters, solenoid valve, Air compressor unit, coolant, pressure gauge. The above figure shows the systematic arrangement of the parts for smooth flow of coolant from the unit for achieving the desired lubrication. Initially the compressed air from air compressor is passed onto the DCV. The DCV is used to give the direction to the compressed air to the desired path so that air can travel through the pipes and can enter into spray. From DCV the compressed air is filtered through the filtration unit which is placed ahead of it. The compressed air from DCV firstly enters into filter where the air is purely filterer, the dust particles and foreign particles if any are present in the air are filtered in filtration unit. This pressurized air further enters into pressurized liquid tank from one inlet. The pressurized liquid tank consists of two ports i.e., inlet and

outlet ports. Pressurized air enters the tank from inlet port. The pressure gauge is present on the tank to determine the pressure of the coolant flowing through the tank. The pressurized air along with coolant flows from the tank outlet towards the spray gun. From air compressor the filtered air through solenoid valve enters into the spray gun from the remaining port. The spray pattern adjuster is used to adjust the pattern of the spray and to control the flow of the coolant for lubrication. If heat generated during casting operation is more than spray pattern is adjusted accordingly so that the coolant flow speed is high

IV ADVANTAGES

1. Highly time saving as the separate sprays are used for individual cavity in the die.
2. Coolant used is in limited amount. Since the sprinkle pattern is used the coolant used is less and wastage of coolant is avoided.
3. Design of spray pattern can be adjusted according to the requirement of the operator.
4. The speed flow of the coolant can be adjusted by using the speed adjuster.
5. Operator does not need to carry the coolant gun all the time in hand for spraying.
6. Faster is the production rate.

V CONCLUSION

The usage of automatic coolant spray unit helped operator to be physically free from mechanical stress. It also enhanced time consumption since the spray is sprayed on all the die cavities simultaneously. The system is highly flexible because the system functioning can be changed according to the application by changing the program for operation. The number of sprays also can be adjusted if the cavities present on the die are more. Hence implementation of automatic coolant spray unit leads to large investment cost but reduces the mechanical effort and increases the productivity to larger extent due to time saving.

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