United States Patent Office

3,090,166

Patented May 21, 1963

3,090,166

POLISHING METHOD AND DEVICE

John C. Straub, South Bend, Ind., assignor to Bell Intercontinental Corporation, South Bend, Ind., a corporation of Delaware

Filed Feb. 17, 1959, Ser. No. 793,764
11 Claims. (Cl. 51—9)

This invention relates to the art of polishing or surface finishing and it relates more particularly to a method and means for polishing the surfaces of metal and the like materials in a low cost, continuous, mass production process.

Surface treatment to produce a polish has, to the present, been achieved in a number of ways. Other than hand rubbing or buffing, a polished surface can be secured mechanically by the use of a tumbling barrel wherein a plurality of the pieces of the work to be polished are tossed about in combination with a buffing or polishing agent. The tumbling process for polishing constitutes a batch operation wherein the number and size of products to be finished are quite limited. The tumbling process is not available for use in a continuous operation or for the treatment of relatively large or endless surfaces, or for parts subject to damage by impact of the parts tumbling upon themselves.

Another process, employed commercially, makes use of a buffing wheel which is brought into surface contact with the work to provide a buffing action which, in combination with a buffing agent or polish, produces a desired surface finish on the work. The buffing wheel is applicable to large pieces of work or endless surfaces as distinguished from small pieces of work which are more easily processed in a tumbling barrel. Unlike a tumbling barrel, however, the buffing wheel process can be adapted to individual or continuous operations but like the tumbling barrel, it requires considerable attention and the equipment is subject to considerable wear or deterioration. In addition, it is a relatively slow and costly process.

It is an object of this invention to provide a method and means for adapting the concepts of a blast for producing a polish on the surfaces of work, and it is a related object to provide a polishing means which relies on elements being thrown at high velocity onto the surfaces of work which is independent of the size or shape of the work; which is flexible in operation either on a batch or continuous process; which is capable of operation at low cost and at high speed to provide an inexpensive or economical polishing process; which makes use of readily available equipment and materials; and which is capable of continuous use on endless strips of metal to provide a low cost mass production polishing process of the type which is not now available to the art.

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

FIG. 1 is a schematic elevational view of the elements employed in the practice of this invention;

FIG. 2 is a sectional view taken substantially along the line 2—2 of FIG. 1;

FIG. 3 is a schematic view of a modified form of throwing means which may be employed in the practice of this invention, and

FIG. 4 is an elevational view schematically showing the modified form of the throwing wheel of FIG. 3.

To the present, widespread use has been made of blasting machines for cleaning surfaces of work, such as metal castings, weldments, rolled steel and the like, by blasting the surfaces of the work with suitable abrasives such as grit, sand, shell particles, and the like materials. While

sand blast with air or wet blast with water found use in many applications, the greatest use in surface treatment has been made of multiple bladed wheels which are rotated at high speed for throwing the abrasive particles onto the surfaces of the work. Blasting wheels of the type referred to above are fully described in United States Patents Nos. 2,049,466, 2,204,633 and 2,708,814.

Such blasting processes as are represented by the use of centrifugal blasting wheels have been employed effectively to work or peen the surfaces of metal with steel shot or grit, or to clean the surfaces of work by removal of rust, burrs, sand, and the like, by the use of sand or abrasive. Invariably, the surface is left with a rather roughened or matt surface such that such centrifugal blasting processes had been used to remove polish from a surface and to leave a rather dull surface finish. No one, to the best of applicant's knowledge, has been able to reverse the process and make use of a blasting wheel for surface polishing as distinguished from surface roughening. Applicant and others associated with applicant have devoted considerable thought and effort towards the adaptation of the mass production process of blasting to the problems of producing a surface polish in a continuous operation. To the present, all such efforts have led to failure in that the product of the blast has been in a direction away from a surface polish.

It has now been found that the blasting technique can be used to produce a polish on surfaces such that it may now be possible to adapt the low cost blasing techniques to a polishing process under certain prescribed conditions. In accordance with the concepts of this invention, a polish can be secured on the surface of work if the material blasted onto the surface is a particulate substance which is formed of a resilient material and if the particulate substance engages a surface in a manner to provide relative movement between the surface of the particle and the surface of the work in the presence of a polishing or buffing agent.

In the preferred practice of this invention, the particulate substance is thrown onto the surface of the work with a combination of linear movement in a direction towards the work and with a spinning action such that relative movement between the surface of the particulate substance and the surface of the work occurs during the time that the particulate substance is pressed against the surface of the work upon impact and before it rebounds. The action may have the characteristics of a wiping or a skidding action of the particulate material over the surface of the work.

As the resilient material thrown onto the surface of the work for polishing, use can be made of a material having a high or low modulus of elasticity, depending upon the work to be polished and the finish to be accomplished. For example, a different modulus of elasticity might be used for the first stage, or rough polish, than for intermediate or final polish. Preferably, the modulus of elasticity of the material would be less than 400,000 pounds per square inch. Included are such materials as natural or synthetic rubbers and elastomers, polyethylene, polybutylene, polyamides, polyesters, cellulose acetate-butyrate, nitrocellulose polyvinyl acetate, polyvinyl chloride, vinyl chloride, vinyl acetate copolymer, and the like. Such materials may be cut or molded or otherwise formed to pellets of cubical, cylindrical or other polygonal shape but it is preferred to make use of pellets which are cut or molded to spherical shape. The size of the pellets is somewhat dependent upon the dimension and shape of the surfaces to be treated but the bigger the pellet the faster the polishing action. For example, pellets of 1" in cross section are more desirable than pellets of ⅛" where the surface to be treated is relatively flat and large. But, the smaller pellets would be more desirable where sharp internal contours are present in the surface of the work. It is preferred to make use of pellets within the range of ⅛" to 2" in cross section. Pellets within the higher range of modulus of elasticity, or harder pellets tend to give a faster polishing action. This is probably because a greater amount of pressure of the pellets on the work would result from a higher modulus at a given linear speed. It should be understood however that in some cases it may be better to select a lower modulus of elasticity and a higher linear velocity. To give weight and inertia to the pellets, the pellets may be formed of a core or cores of high specific gravity confined within a sheath or covering of the material having the desired softness or modulus of elasticity. For such purposes, use can be made of cores of lead or other metal or material of higher specific gravity than the surrounding portion.

As the buffing agent or polishing agent in contact with the surface when engaged with the pellet, use can be made of conventional polishing agents such as magnesium oxide, alumina tripoli iron oxide (rouge), Novaculite, aluminum oxide, and the like in powdered or other finely divided form. The particle size of the buffing agent will have some influence on the polish since a higher polish will tend to be secured with the finer particles, and a rougher polish being secured with the larger particles. Thus, the polishing process can be controlled, at least in part by the sequence of the polishing agents used in the process. The buffing agent can be applied to the surface of the work in advance of or in combination with impact by the pellets. For such purposes application of the polishing agent can be made by a wet or dry spray process or by roller or drip coating the polishing agent onto the surface with or without a suitable carrier. It can also be applied to the pellets just prior to their impact with the work by placing a paste or cake of polishing agent in the path of the pellets, disposed in such a way that the pellets strike such polishing agent at a small angle in keeping with the direction of spin.

Instead, the polishing agent may be applied onto the surface of the pellets or otherwise incorporated onto the surface of the pellets thrown onto the surface of the work. Another practice would be uniformly to distribute the polishing agent throughout the pellet when it is formed so that the polishing agent will form a part thereof to the extent that the polishing material will always be exposed on the surface for engagement with a surface of the work, independent of the wear of the pellet and without the need for other applications and controls. When incorporated into the resilient or rubber-like pellets, the polishing agent may function as a filler and may be incorporated within the amount of five to forty percent by weight of the final product.

The presence of liquid, such as moisture, on the surface of the work at the area of impact is advantageous to the described polishing process. Thus, it is preferred to apply the polishing agent or powders while contained in a liquid carrier uniformly to coat the surface of the work and thus to provide liquid or moisture on the surface. Instead of the polishing agent, a liquid may be separately applied to the surface of the work in any desired sequence before or concurrently with the impact of the pellet thrown onto the surface of the work.

Some relative movement is secured when the pellets are thrown at a low angle onto the surface of the work, such for example as at an angle less than 40° with the surface of the work and, preferably, at an angle of five to fifteen. It has been found, however, that a substantially improved and different action is made available by a pellet spinning at high speed upon engagement with the surface of the work. Where possible, best results are secured by a combination of a spinning pellet thrown at a low angle onto the surface of the work, preferably with the work being inclined in the direction opposite the peripheral movement of the spinning pellet so that the pellet would tend to roll

on the surface in a direction opposite its linear movement, as illustrated in FIGS. 1 and 3.

Various means may be employed for imparting linear and spinning movements to pellets **10** thrown at high speed onto the surface **12** of the work **14**.

One such means, illustrated in FIGS. 1 and 2, comprises a conventional blasting wheel **16** formed of a pair of spaced metal disc members **18** and **20** having a plurality of blades **22** extending radially outwardly from a distance short of the center of the wheel to the periphery with the blades preferentially being spiral in shape from the inner end outwardly to extend in the direction of turning movement of the wheel. Thus pellets **10** fed through the central opening **24** of the wheel onto the inner ends of the blades will have a spinning action imparted thereto as they roll outwardly on the surfaces of the blades in response to the centrifugal force imparted to the pellets as the wheel is rotated rapidly about its axis. The feed mechanism can correspond to that described in the aforementioned previously issued patents for the displacement of abrasive onto the inner ends of the blades to be thrown from the periphery of the wheel in response to rotation of the wheel at high speed.

While it is preferred to make use of curvilinear blades having the curvature in the direction of rotational movement of the wheel, a satisfactory linear and spinning motion can be imparted to the pellets by the use of straight blades or blades which are curved in either direction.

While blades having a flat surface may be employed, the amount of rolling or spinning action can be materially increased and more effectively controlled if the blades are formed with a plurality of laterally spaced apart longitudinal grooves in the surface thereof. This enables the pellets **10** to roll outwardly along the blade on a diameter smaller than the diameter of the pellets, as illustrated in FIG. 2. In the illustrated modification, the rolling radius would correspond to the pellet radius times the sine of the half angle of the groove.

The work **14**, represented as a strip of metal of substantial length, can be advanced continuously in a direction across the wheel and across the path of the pattern of pellets thrown from the wheel so that all of the surface of the strip aligned with the wheel will be engaged by the spinning pellets. The strip can be advanced across the pattern perpendicularly to the path of the pellets but it is preferred to arrange the strip or work at a relatively low angle to the path of the thrown pellets which angle opposes the spinning action of the pellets so that the pellets will tend to roll up the strip upon engagement.

Polishing agents or powders can be coated onto the surface of the strip **14** before or during its exposure to the pattern of the thrown pellets. Application can be made by one or more roller coaters or by a group of spray guns **26** arranged to extend crosswise of the strip to apply the agent onto the surface to be engaged by the pattern of pellets. For purposes of lubrication and for purposes of carrying and holding the polishing agent or powder onto the surface of the work, the material sprayed or otherwise applied onto the surface can be formulated of the polishing agent dispersed in a liquid system, such as water. Instead, the polishing agent or powder can be sprayed directly into the pattern of pellets thrown from the wheel to be carried with the pellets onto the surface of the work. Although the above is the preferred method, the polishing agent or powder can be introduced directly onto the pellets before or after being thrown.

In FIGS. 3 and 4, illustration is made of another means whereby spinning and linear movement can positively be introduced into pellets thrown at high speed onto the work surface for polishing. In the illustrated modification, use is made of a wheel **40** mounted for rotational movement at high speed about its axis **42**. Cooperating with the wheel and partially surrounding its periphery is a stationary member **48** in the form of an elongate member having a curvilinear portion spaced from the peripheral surface of a portion of the wheel by a distance to accommodate the pellets 10 therebetween. The surface of the stationary member 48 facing the wheel 40 can be formed flat but it is preferred to form circumferential grooves 50 therein, as illustrated in FIG. 2. The wheel is formed with a cylindrical surface or with a circumferential surface 44 having a plurality of annular grooves 46 formed therein.

The pellets 10 are fed from a hopper 52 into the space 54 between the periphery of the wheel and the upper end of the stationary member 48. The pellets enter the aligned grooves between the wheel and member and are caused to roll downwardly between the wheel and the member as the wheel is rotated at a high peripheral speed about its axis. Thus, a positive spinning action is imparted to the pellets as the pellets travel downwardly between the wheel and the stationary member so that when the pellets are thrown from the periphery of the wheel they will have a high spinning action. By this means it is possible to secure better control of the direction in which the pellets are thrown thereby more effectively and efficiently to control the pattern of pellets thrown from the wheel. The desirable rotational movement will be imparted to the pellets thrown from the wheel even when either or both of the members are formed with flat surfaces but greater spinning action will be achieved by the grooved stationary members for the reasons previously pointed out. Where abrasion forces permit, the surface of the blades or wheels may be formed of a material having a high coefficient of friction to insure the rotational movement of the pellets passing thereover. It will be apparent that, since the rolling radius of the pellet is equal to the pellet radius times the sine of the half angle of the groove, various combinations of groove angles can be used advantageously for obtaining the desired spinning speed in relation to the linear speed.

The work 14 is advanced linearly across the pattern of pellets thrown from the wheel. The surface 12 can be previously coated with a polishing agent or powder or such polishing agent may be applied as by the sprays 26 onto the surface of the strip immediately in advance of or in combination with the pattern of pellets thrown onto the work.

It will be apparent from the foregoing that I have provided a new and novel means for achieving a polishing action on work and that the means described is capable of low cost and continuous operation for a mass production process in the polishing of surfaces such as metal strips and the like.

It will be understood that other means may be employed for imparting the desired linear and rotational spinning movement to the pellets and 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. The method of polishing the surface of work comprising hurling onto the work spherically shaped pellets of a resilient material in a linear direction while positively and simultaneously imparting a movement to the pellets for rotational movement about their axes for engaging the surface of the work with a linear component and with a simultaneous spinning movement, and supplying polishing agent to the surface of the work during engagement of the pellets whereby the surface of the work is polished.

2. The method as claimed in claim 1 in which the work is positioned at an angle to the linear direction of the pellets thrown onto the surface of the work.

3. The method as claimed in claim 1 in which a polishing agent is provided as a coating on the surface of the work.

4. The method as claimed in claim 1 in which the polishing agent is applied by introducing the polishing agent into the pattern of pellets thrown onto the surface of the work to be carried by the pellets onto the work.

5. The method as claimed in claim 1 in which the polishing agent is present as a component of the pellets to be present on the surface brought into contact with the work.

6. A polishing device adapted for the blast polishing of a positioned work piece comprising a wheel mounted for rotational movement, feed means for introducing pellets of a resilient material to the wheel whereby the material is centrifugally thrown in a linear direction from the periphery thereof responsive to rotation of the wheel at high speed, grooves in the surface of the wheel over which pellets travel during rotation of the wheel and wherein the grooves are dimensioned to receive a peripheral portion of the pellets during travel thereover to give the pellets a movement for rotation about their axes simultaneously with the linear component whereby the pellets thrown from the wheel have a linear component and a spinning component about their axes, and means for supplying the surface of the work with a polishing agent in contact therewith when engaged by the pellets thrown from the wheel.

7. A polishing device as claimed in claim 6 in which the wheel comprises a bladed wheel with the blades extending radially outwardly from a feed means at the center and in which the grooves are laterally spaced apart in the surface of the blades and extend substantially continuously from the inner end portion to the outer end portion of the blades.

8. A polishing device as claimed in claim 6 in which the wheel comprises a cylindrical disc shaped member mounted for rotational movement at high speed and a stationary member having a curvature corresponding to the periphery of the wheel and mounted in spaced concentric arrangement with a peripheral portion of the disc wheel with the grooves circumferentially arranged in laterally spaced apart relation in at least one of the adjacent surfaces including the wheel and the stationary member.

9. A polishing device as claimed in claim 8 in which the periphery of the stationary member is formed with the plurality of laterally spaced apart grooves corresponding to the grooves in the periphery of the wheel.

10. A polishing device as claimed in claim 8 in which the periphery of the wheel is formed with the plurality of laterally spaced apart annular grooves.

11. A polishing device as claimed in claim 8 in which the stationary member is spaced from the periphery of the disc wheel by an amount slightly less than the thickness of the pellets adapted to be displaced therebetween.

References Cited in the file of this patent

UNITED STATES PATENTS

2,135,550	Alexander	Nov. 8, 1938
2,205,414	Keefer	June 25, 1940
2,423,287	Beisel	July 1, 1947
2,663,980	Harper	Dec. 29, 1953

May 21, 1963 J. C. STRAUB 3,090,166

POLISHING METHOD AND DEVICE

Filed Feb. 17, 1959

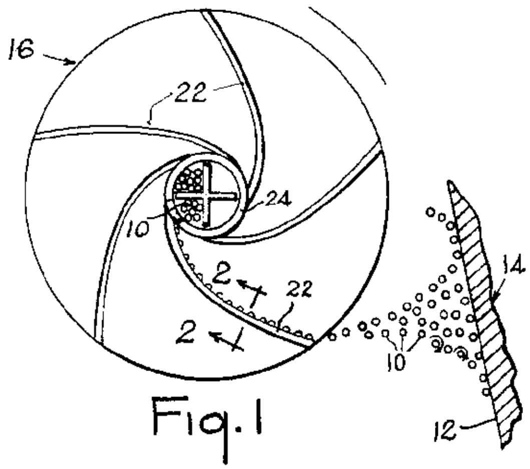

Fig. 1

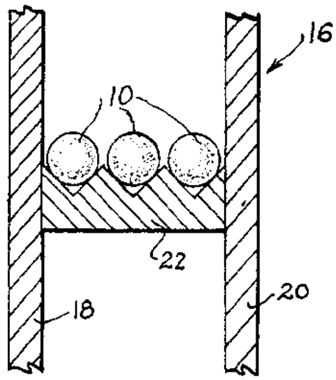

Fig. 2

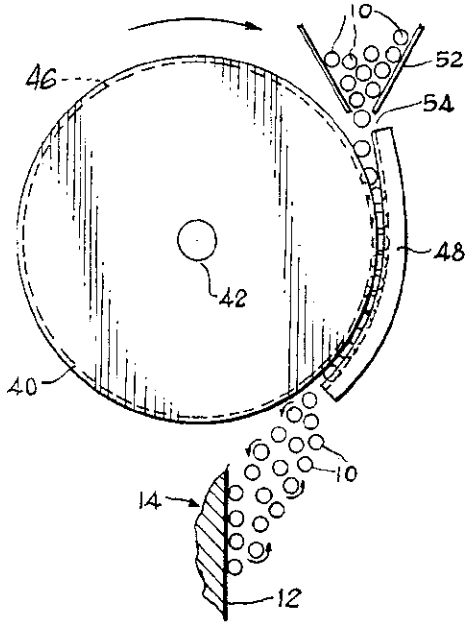

Fig. 3

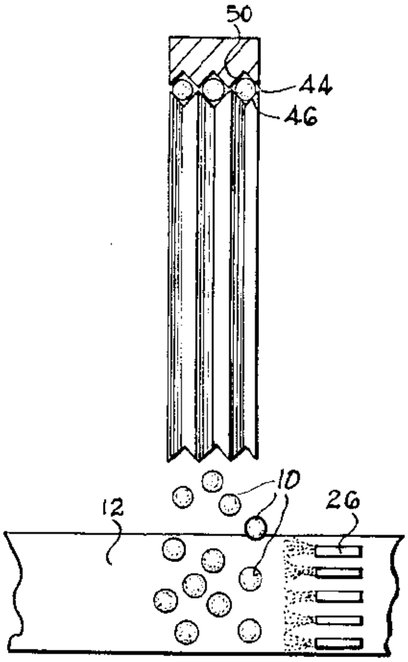

Fig. 4

INVENTOR.
John C. Straub
BY
Ooms, McDougall, Williams & Hersh
Attorneys