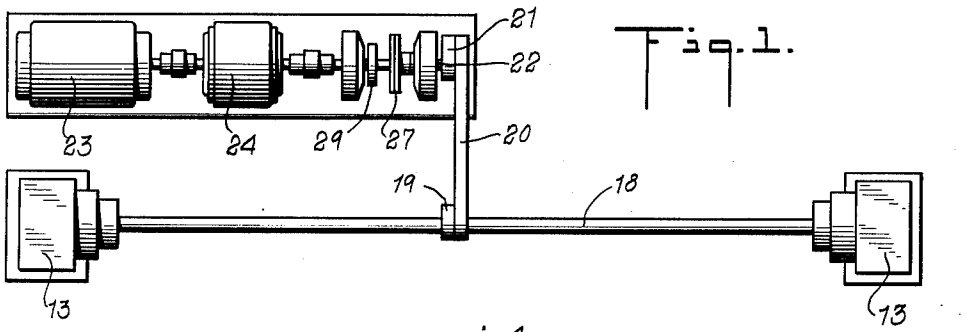
Dec. 2, 1952 W. MacWILLIAM 2,620,284

METHOD FOR SPRAYING ROTATING RADIAL SURFACES

Original Filed Jan. 24, 1949 2 SHEETS—SHEET 1

Fig. 1.



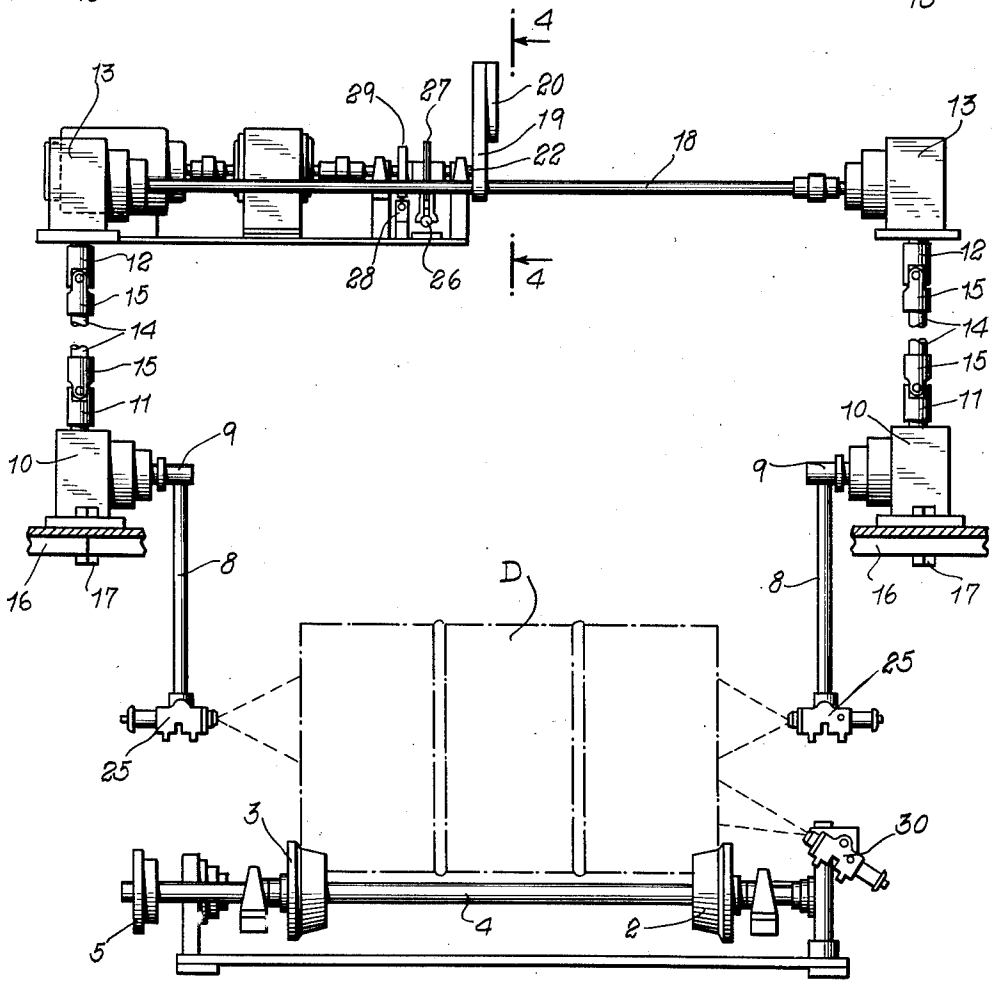


Fig. 2.

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Fig. 3.

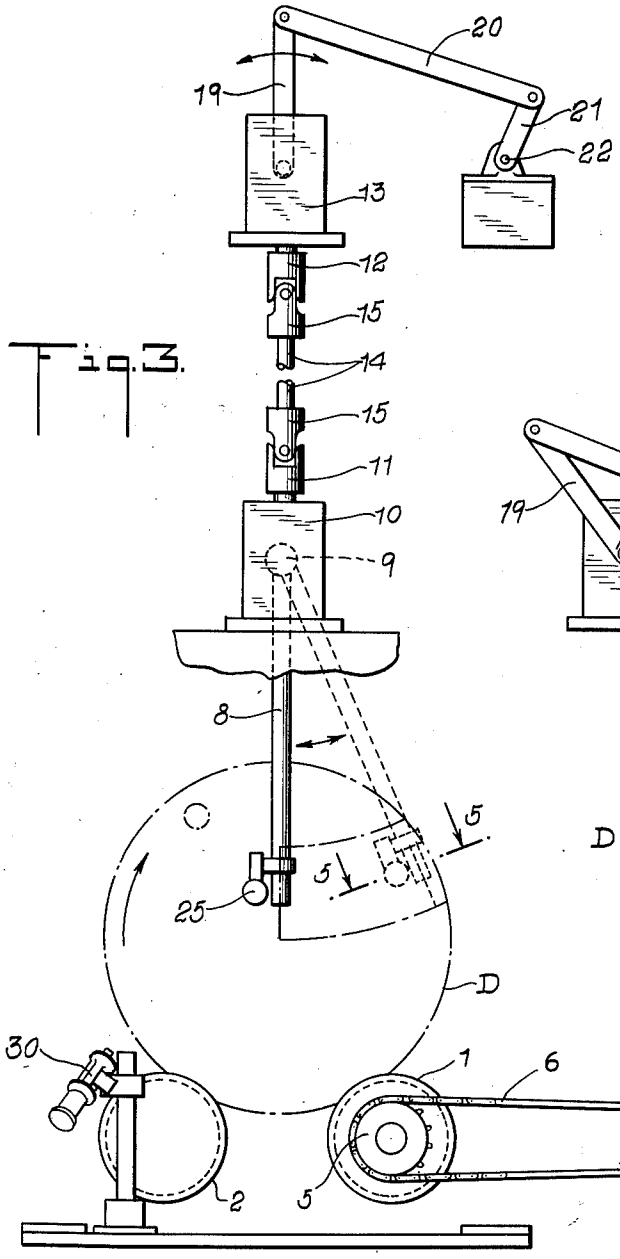


Fig. 4.

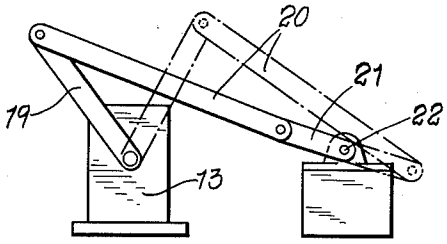
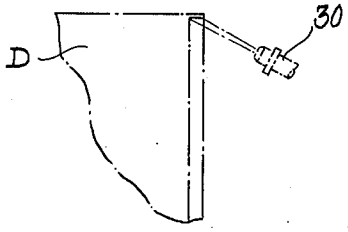


Fig. 5.



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METHOD FOR SPRAYING ROTATING RADIAL SURFACES

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Original application January 24, 1949, Serial No. 72,411. Divided and this application October 27, 1950, Serial No. 192,412

2 Claims. (Cl. 117—94)

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This invention relates to the problem of uniformly spraying rotating radial surfaces. For example, steel drum heads may be painted by revolving the drum about its axis and using fixed paint spray guns pointing towards its opposite drum heads. But the peripheral portions of these rotating radial surfaces travel faster than their central portions so the latter receive a greater amount of paint than the peripheral portions per unit of time. This results in a radially uneven coating which is undesirable. The thus presented problem has not been satisfactorily solved heretofore either by using multiple guns fixed at each drum head or by using movable guns adapted to traverse the drum heads.

One object of the present invention is to spray rotating radial surfaces in a uniform manner. This application is a division from application Serial No. 72,411, filed January 24, 1949, on which Patent No. 2,613,635 issued on October 14, 1952. This patent contains claims covering the apparatus disclosed herein.

The presently preferred form of the invention is illustrated by the accompanying drawings as embodied in an automatic drum head spray painting machine, the various figures being as follows:

Fig. 1 is a top view of a drive and countershaft assembly forming the top portion of the machine, certain lower elements being eliminated in the interest of clarity;

Fig. 2 is a side view of the complete machine showing the drive and countershaft assembly of Fig. 1 and its location, and all the other parts therebelow and including in broken lines a steel drum with its heads being spray painted;

Fig. 3 is an end view of Fig. 2;

Fig. 4 is a cross section of the drive and countershaft assembly taken from Fig. 2 as indicated by the line 4—4; and

Fig. 5 is a fragmentary view taken from the line 5—5 in Fig. 3 for the purpose of showing a spray angularity not adequately illustrated otherwise.

In these drawings the drum D is shown by broken lines. The machine provides a cradle formed by four rectangularly arranged wheels 1 which are generally shaped like railroad wheels so they provide inwardly tapered drum supporting surfaces 2 having flanges 3 for engaging the drum ends and preventing axial drum motion. The drum is horizontally cradled by these wheels 1 with the latter appropriately positioned by horizontally journaled shafts 4 of which both are rotatively powered by the sprocket wheel 5 connected by the sprocket chain 6 with the sprocket

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wheel 7 on the shaft of an electric rotory motor M. Those wheels 1 which are on the shafts are keyed thereto. Therefore, operation of the motor M, which is an electrical motor whose speed is capable of good control, serves to rotate the drum D about its axis with this axis relatively fixed due to the form and arrangement of the wheels 1 which carry it.

Levers 8 are each fulcrumed on an axis parallel to and radially offset from the rotary axis of the cradled drum D by being keyed to the horizontal shafts 9 of right angle gear drives 10 having their vertical shafts 11 connected to the vertical shafts 12 of other generally similar right angle gear drives 13, by vertical shafts 14 provided with universal joints 15. The drives 10 are elevated above the drum D when it is supported by the wheels 1 and the drives 13 are above the drive 10 with the shafts 14 and the universal joints 15 permitting horizontal movement of the drives 10 axially of the drum D. For this purpose the drives 10 are slidably mounted on horizontal supports 16 and provided with releasable fastenings 17 for fixing the position of the drives 10 and hence the levers 8 relative the drum heads. These horizontal supports 16 may be supported by an adequate superstructure or suspended from the shop ceiling, this applying also to the drives 13 and any other elevated equipment. The particular arrangement used for this purpose is not illustrated in the interest of avoiding confusion in the drawings.

The horizontal shafts of the right angle gear drives 13 are interconnected by a countershaft 18 to which a lever 19 is keyed with its swinging end connected by a connecting rod 20 to a crank 21 keyed to a drive shaft 22 powered by an electric rotory motor 23 through a reduction gear drive 24. With this arrangement, as the motor 23 slowly drives the shaft 22 through the gear drive 24, the crank 21 rotates therewith, and the connecting rod 20 oscillates the lever 19 to oscillate the shaft 18 and hence the levers 8 depending from the horizontal shafts 9 of the right angle gear drives 10. The lower ends of the levers 8 are thus caused to traverse the heads of the cradled drum D, and these lower ends mount automatic fan spray guns 25. These guns are of the type like a manual fan spray gun, excepting that they are operated by a pilot plunger adapted to be remotely controlled by the admission of pilot air pressure. It should also be understood that a fan spray is a relatively flat flaring spray ejected from a spray gun having a spray head designed to so shape the spray.

The fan spray guns 25 are mounted by the lower ends of the levers 8 so that the fan spray is ejected approximately in alignment with the levers 8 in each instance. The levers 8 are shown as having lengths approximately equaling the drum diameter, and their mounting shafts 9 are positioned high enough so that the lower ends of the fan sprays terminate about at the drum axis. The shafts 9 are positioned in radial alignment with the drum axis and are vertically thereabove and when the levers 8 are swung in alignment with the drum axis and the axes of the shafts 9, the fan spray is oriented approximately radially respecting the drum head in each instance. When the levers 8 are swung outwardly so they are opposite the periphery of the drum or are close thereto the fan spray is oriented approximately tangentially respecting the drum head in each instance. At positions in between the fan spray rotates so as to provide transitional orientations between the radial and tangential orientations at the inner and outer extremes of its swing in each instance. The spray guns 25 are each arranged to eject their fan sprays transversely towards the drum heads and in each instance at outwardly inclined angles as shown by Fig. 5.

All of the right angle gear drives have 1 to 1 gear ratios and the upper drive and countershaft assembly is organized so that when the crank 21 is aligned with the link 20 the arms 8 are opposite the periphery of the drum heads and when the crank 21 and connecting rod 20 are at right angles the levers 8 are at the axes of the drum heads. The organization is such that at this time the lever 19 is vertical. This lever 19 oscillates with rotation of the crank 21 as it is driven by the motor 23. Thus the arms 8 oscillate back and forth while completely traversing the drum heads.

The illustrated machine is designed for full automatic operation, the automatic spray guns 25 having their pilot pressure connected with a pilot valve 26 worked by a cam 27 on the shaft 22. There is also a limit switch 28 worked by a cam 29 on the shaft 22. This limit switch 28 is connected by an electric circuit to control the motor 23 so that upon initial energization the crank 21 makes one complete rotation and then stops until the circuit is energized again, with a manually operated push button used to initiate each cycle. The cam 27 is arranged so that as the crank 21 starts to align with the connecting rod 20 while the levers 8 are at their outer swinging extremes where the fan spray guns 25 are pointing outwardly as shown by Fig. 5, pilot pressure is admitted to the guns 25 so that they start to eject their fan sprays, and this is continued until the levers 8 swing to positions where they are opposite the central portions of the drum heads with the fan sprays extending radially from the drum head axis, whereupon the pilot pressure is discontinued so the spray ceases.

In the above operation the drum D is, of course, rotating when the spray guns are pointing towards the peripheral portions of its drum heads. These drum heads receive at this time the maximum amount of spray peripherally for each revolution because of the tangential orientations of the fan sprays. The arrangements should be such that as spraying starts the fan sprays are pointing at their outward inclinations so that their spray ends just reach into the chines of the drum, the outward inclinations assuring that these chines are thoroughly sprayed.

As the crank 21 and link 20 begin to leave their aligned positions the mechanical advantage is so great that there is time for the drum heads to turn at least twice so as to positively avoid an unsprayed portion between the ends of the fan sprays. There is no chance for the side of the drum to be sprayed because of the outward inclinations of the spray guns, this being another important advantage of this angularity since it is frequently desired to paint the sides of the drum a different color from its heads.

As the crank 21 continues to rotate and gradually approach right angularity with the connecting rod 20, the traversing speeds of the arms 8 correspondingly increase in accordance with the laws of mechanics involved. Since the spray guns are rigidly fixed to the ends of the arms 8 and the latter are swung about the axis formed by the shafts 9, the fan sprays gradually leave their tangential orientations and rotate, in effect, about their own axes relative the drum heads and as they begin to approach their radial orientations they are swinging faster. The drum head portions that are sprayed are, of course, moving slower since they are closer and closer the drum axis. By proper relation of these various effects the drum heads may be sprayed in a completely uniform manner.

The rotating speed of the drum must be correlated to the swinging speeds of the levers 8 to prevent the fan sprays from forming spiral patterns on the drum heads. This is particularly important while the arms are opposite the peripheral portions of the drum heads with the fan sprays oriented tangentially respecting the drum heads.

Knowing the fan sprays' dimensions, the dimensions of the various levers and of the crank 21, and the latter's rotating speed, it is possible to mathematically compute the proper drum rotating speed required. With the motor 7 capable of good speed control it is also possible to vary it as required to visually produce the desired uniform results.

In the case of the specific example illustrated, the drum heads are 23¼ inches in idameter and the motor 7 is set to rotate the drum at 110 R. P. M. The fan spray pattern is 6 inches long and ½ inch wide or thick, and the levers 8 are about 24 inches long. The right angle gear drives all have 1 to 1 gear ratios, and the crank 21 and lever 19 are dimensioned as required to fully swing the levers 8 from the drum heads periphery to the center while the crank 21 turns from alignment with the connecting rod 20 to the right angular association therewith. With this arrangement a crank speed of 8.24 R. P. M. produces the desired results. The fan sprays are set to automatically start as the crank 21 reaches dead center and before it can break its toggle linkage with the lever 19 the drum heads have time to turn enough to avoid uncoated peripheral portions. The cam 27 is set to cut off the pilot pressure, to the automatic spray gun, just as the fan sprays become aligned with the drum heads axis. This means that the levers 8 swing a little beyond the axis of the drum, it being remembered that the fan spray guns are set to eject their fan sprays at the outward inclinations required to paint the chines and avoid painting of the drum sides.

Some difficulty may be experienced in properly spray painting the bung hole, so the machine is provided with a fixed automatic spray gun 30 which may eject an ordinary round spray in

alignment with the bung hole, it may be used when required for this special purpose.

It is to be noted that a manual fan spray gun may be manipulated to imitate the motions obtained by this machine. This involves a method phase that is believed novel. Although apparently more complicated, the various orientations and traverse of the fan spray might be imitated more or less by using a true linear traverse with rotation of the fan spray effected by cam action or the like. Various other ways may be suggested by those skilled in the art for doing substantially the same thing in substantially the same manner as disclosed by the description of this specific form of the present invention.

The fan spray has been described as oriented approximately tangentially respecting the drum head or disk. With the lever **8** arranged so that when it is at the drum head's center it is truly radial therewith, as illustrated, better results may be obtained by orienting the fan spray, by arranging the gun, so the spray is at a 15° angle with the lever. It may be given an angle as large as 45° with the lever and still provide some of the described advantages. But the fan spray should in each instance be substantially or approximately tangential to the rotating disk being coated.

I claim:

1. A method for substantially uniformly spraying an article having a substantially flat circular surface, said method comprising rotating said article so as to rotate said surface about its axis, ejecting a fan spray transversely against said surface, moving said spray in a generally radial manner respecting said surface to traverse the radius thereof, and, during said moving, orienting said spray so that it is substantially tangential to the rotation of said surface while at

the periphery of said surface and so that it is substantially radial to said surface while at the center of said surface and so that said spray progressively rotates about its own axis from one of said orientations to the other thereof while moving from one of said positions to the other of said posiitons.

2. A method for substantially uniformly spraying an article having a substantially flat circular surface, said method comprising rotating said article so as to rotate said surface about its axis, ejecting a fan spray transversely against said surface, moving said spray in a generally radial manner respecting said surface to traverse the radius thereof, and, during said moving, orienting said spray so that it is substantially tangential to the rotation of said surface while at the periphery of said surface and so that it is substantially radial to said surface while at the center of said surface and so that said spray progressively rotates about its own axis from one of said orientations to the other thereof while moving from one of said positions to the other of said positions, the speed of said moving and the length and width of said fan spray being correlated respecting the rotating speed of said surface to effect a substantially uniform spraying of said surface throughout its extent.

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