The object of my invention is to apply a coating to an object, and to sharply delimit or set-off the coated portion of the object from the uncoated portion. I accomplish this object by applying material to the article and by impinging a current of gas, such as air, on said jet at an angle thereto, so as to form a deflecting and guiding shield of air to produce a sharp limit or edge on the coated surface.

The subject of my invention is an automatic coating machine for accomplishing the above objects. It consists essentially of, means for conveying a plurality of articles to be coated, a spray gun for applying a jet of coating material to each of said articles in succession, and means for limiting the application of said jet upon said article by impinging a current of gas on said jet at an angle, or by forming an air-shield for said coating jet.

A further feature of my invention is the provision of means actuated by each of said articles in succession for controlling the operation of said spray gun and said nozzle which constitutes the means for impinging the gas or air-shield.

A further feature of my invention is the provision of a plurality of nozzles for limiting the application of said jet to said article in a plurality of directions by impinging a plurality of currents of gas on said jet at different angles, or a plurality of adjustable air-shields.

My invention also consists in the process of applying a coating to a portion of each of a plurality of objects, and clearly delimiting or setting-off the coated portion from the uncoated portion.

My invention relates to machines and methods for painting or coating objects such as collapsible tubes with such materials as paints, lacquers, cements or anti-wetting compounds of fluid or viscous nature and more particularly to the applying of coatings to the walls of tubes within definitely controlled limits of area.

The collapsible tubes to be coated are used as dispensing containers for such materials as shaving creams, medicinal ointments, food products, etc., and usually consist of a thin walled body portion, open at one end to receive the content, and having a breast at the other end, which usually is provided with means to hold a removable dispensing cap. The tubes are, or may be, made from some soft alloy such as tin, lead or aluminum but may also be made of celluloid, textile, paper or some similar material.

Although any kind of fluid or viscous material may be applied to the tubes by the method and machine here disclosed, my invention particularly to the applying of a sealing compound of an adhesive or cementing nature such as Williams No. 69 glue. The purpose is to apply a coating to a portion of the tube which coating will be the means of producing a strong bond within and/or between the folds forming the closure of the open end of the tube, as described and claimed in my co-pending application No. 561,111, filed September 4, 1931, now Patent No. 2,086,111, issued January 14, 1937.

The standard practice now in applying paint, printing and lacquer to the walls of tubes, appears to be the roll process. This process, of course, lends itself readily to the applying of coatings on the outside of the tubes but for the applying of a coating on the inside of the tubes this process cannot be used. Attempts at the use of a spray gun for applying the outside coating have been made but failed on account of the imperfect control of the spray jet. In applying anti-wetting compounds such as paraffin, latex or gelatinous materials, which material usually has been applied in a narrow ring around the inside of the open end of the tube, the work has been done mostly by hand either by dipping or the use of a brush. The limited number of tubes coated by hand has, on account of the slow process, had to carry an extra cost of from 10 to 15¢ per gross. By my method and through the use of my invention the above extra cost is reduced to an insignificant small percent of the figures mentioned, and the process is made commercially practical for any fluid or viscous material and for the applying of a coating either inside or outside or both inside and outside simultaneously.

Some of the features embodied in my invention are: means for holding and conveying tubes or similar articles; means for applying a coating of a desired compound by the use of a spray gun; means to locate the coating at the desired place on the article; means to control and limit the space covered in coating; means to rotate the article being coated; means for controlling the length of time used in the process of applying the coating; means for quickly drying the applied coating; means for removing the mist and fumes; and other features which will be more specifically pointed out and described.

In the drawings:
Fig. 1 is a diagrammatic view showing features of my device;
Fig. 2 is a diagrammatic view, with parts broken away, illustrating my novel process;
Fig. 3 is a diagrammatic view, with parts broken away, illustrating a modified type of process;
Fig. 4 is a fragmentary view, with parts broken away, in vertical cross-section;  
Fig. 5 is a side elevation, with parts broken away, in vertical cross-section through my machine;  
Fig. 6 is a cross-section on line 6-6 of Fig. 7;  
and  
Fig. 7 is a plan view of a portion of my machine, with parts broken away, in horizontal cross-section.  

10 is a base supporting the parts of the machine and enclosing the drive mechanism.  
11 is a revolving dial representing one form of conveyor for carrying a plurality of rotatable spindles 12 each with a suitable tube-cup or holder 13. These tube-cups are interchangeable so that different sizes of tube-cups may be used to carry different sizes of tubes. The dial 11 is mounted on the axle 14 which is supported by and rotates in the bearings 15 and 16 fastened to base 10.  

A cam shaft 17 is driven from a prime mover (motor) 18 through geared head 19, pulleys 20, 21 and belt 22. On the cam shaft 17 is mounted a worm 23 which drives the axle 14 through worm gear 24 at a suitable ratio depending on the number of tube holders carried by the conveyor 11. The speed ratio may be of arbitrary selection, but for my purpose in this case I am rotating the cam shaft 17 at the speed of one revolution for each tube holder carried by the conveyor 11. The tubes A to be coated come in all kinds of sizes and lengths and to adopt the machine to any length tube within the range of the machine either the spray mechanism or the conveyor ought to be adjustable. Both may be adjustable in my machine. The conveyor which is adjustable in the proper direction by means of a screw 224.  

In order to get a uniform coating all around an article of this particular shape, I rotate the spindle 12, which carries the tube holder 13, at a suitable speed. This drive might take any convenient form. For an automatic machine of this type I have shown a friction-gear type of drive which may consist in a roller 25 mounted on spindle 12 and driven by a belt, chain or, as shown in the drawings, by another friction roller 26. This driving roller 26 is carried on yieldable, pivoted arms 27 so that the arms may be brought close to the driver 17 when the tubes to be coated are of any length. The roller members will be of maximum duration, the fulcrum 28 for the arms 27 having the bearings 29 and 30 placed so as to bring the driver wheels into contact at the proper time for starting the rotation before the spray gun is operated. The power from the prime mover 18 may be transmitted through suitable gearing or belts 31 and 32. A spring 333 may be used to hold roller 26 yieldably against the driven roller 25 as the rollers 25 pass the point of contact.  

The spray gun 33, hereinafter more fully described, is mounted with a fulcrum-stud 34 on bracket 35 and is connected to the air supply through hose 36 and to the compound tank 31 through hose 38. On the same bracket 35 may be mounted an air nozzle 39 and in the same manner as the gun 33. The triggers 40 and 41 of the gun 33 and nozzle 39 respectively may be operated by the same wires 42 and 43 carried by levers 44 and 45. These two levers may be connected through a link 46 which has an extension 47 much in the form of a pendulum or latch which can be made to engage the intermediate cam lever 48 by the no-tube, no-spray device consisting of a trip finger 49 mounted on the spindle 50 and connected to the pendulum actuating lever 51 through linkage 53.  

On cam shaft 17 is mounted an adjustable cam 52 to actuate the cam follower lever 53 which is connected to lever 48 by linkage 54. The cam 52 is adjustable so as to operate the gun a longer or shorter time, dependent on the consistency of the compound and the size of the tube being coated. Bracket 55 is fastened to a suitable gun port 55 which can be moved by handwidel and 10 screw 56 on the base 10, in or out in relation to the passing tube.  

The exhaust hood 57 extends above and along the sides of the tubes A for about two feet and a distance of their travel and may be connected by ducts 58 at suitable points to an exhaust system. Blowers 59 introduce air jets, for creating an air current to aid and speed up the drying of the coating, to hood 57 at suitable points. The hood 57 may be mounted on supports 60 attached to base 10.  

Figs. 1, 2, and 4 illustrate diagrammatically the main principles of the invention. Tubes A are each held in a suitable holder or tube-cup 21 which is carried in some form of a conveyor and has provisions for rotating it. The tube-cup 21 is carried on cam shaft 17 and is actuated by the conveyor 11. The conveyor is connected to the pendulum actuating lever 51 through link 53. Air at suitable pressure (for example, 20 pounds per square inch) through hose 36. The pressure at the gun may be indicated by a gauge (not shown). The gun 33 is mounted on a holder 84, which in turn is adjustable up and down in the desired direction. In addition to the above limitation usually found with tools of this kind, there exists an inherent fault in the mist that is produced when the nozzle is not kept within desired border lines by the use of an adjustable air nozzle 39 of suitable shape, and the mist is at the same time deflected or kept away from the surface it is desired to keep clean. Nozzle 39 may be moved closer to the point of origin of the jet of coating material from the spray gun 33. The flow of air or other gas from the nozzle 39 may be wider than the tube being coated. The adjustments provided for the nozzle are the same as enumerated for the spray gun. Air at suitable pressure (for example, 10 to 40 pounds per square inch) for the nozzle is connected through hose 62, the pressure being controlled 70.
by a reducing valve (not shown) in hose 63 or by the adjusting screw 35a of nozzle 39, and for the sake of economy, although not necessary as far as the process is concerned, the air blast may be controlled by a valve operated at the same time as the spray gun through trigger 41. To carry away the mist and float as well as any fumes, an exhaust hood 51 is provided and connected to the exhaust system through ducts 58.

The time required for drying the applied coat is of considerable importance. I found that in allowing the coat of certain compounds to dry naturally in the air it took two or more hours before the article could be handled. This excessive time, however, I have reduced to about 15 seconds by surrounding the coated surface with a dry air current, starting the current as soon as the spray is stopped and maintaining it for the required time. One or more air nozzles 59 of similar construction and control as nozzle 39 may be used for this purpose. The exhaust hood 51 may also be of some aid for the speeding up of the drying of the coating.

An ejector is shown in Fig. 5 at 65. This is inoperative all through the cycle except at the point of discharge where it rides up on a cam track 66, Fig. 7, lifting the tube out of the tube holder 13. As the tube is lifted out of the tube holder 13, a flat spring on finger 68 guides the tube and urges it to fall onto the discharge chute 61.

Operation.—Tubes to be coated are placed in the tube cup 13 at the proper station of the machine and as they pass around they will first contact with the index finger 48 which through linkage connection causes the latch 47 to engage with the cam operated levers 46, thus opening the spray gun valve at a predetermined time and holding this valve open the length of time desired for applying the necessary coating to the tube walls. This time is controlled by the adjustment of cam 52. While passing from index finger 48 towards the spray nozzle, tube holder spindle 29 contacts driver roller 26 and the tube is put into rapid rotation while passing the spray jet. After receiving the coat, the tubes pass into the hood 51 where jets of air create currents to rapidly dry the wet surface or surfaces of the tubes, so that when each stage there is no danger of smearing or removing the coat if it contacts with other surfaces. The air used may be dry or even heated so as to decrease the time required for drying. As the tube comes out of the hood, it is ejected onto the discharge chute.

In Fig. 3 there is shown a modification of my invention, in which a plurality of nozzles 39 are used to limit the jet of coating material in more than one direction so as to apply the coating in a stripe on the article to be coated. It will be understood that the coating may be applied to both the inside and the outside of the tube or to either the inside or the outside. I do not intend to be limited save as the scope of the prior art and of the attached claims may require.

I claim:

1. In an automatic coating machine, the combination of a spray gun for applying an atomized jet of coating material to an article, a nozzle for limiting the application of said jet to said article in one direction by impinging a current of gas on said jet after said jet has been atomized and at a point closer to said article than to said spray gun, and a blower for applying a current of gas to said coated article to dry said coating.

2. In an automatic coating machine, means for conveying a plurality of articles to be coated, a spray gun for applying an atomized jet of coating material to each of said articles in succession, a plurality of nozzles for limiting the application of said jet to each in a plurality of directions by impinging a plurality of currents of gas on said jet after said jet has been atomized and at points closer to said article than to said spray gun in different directions, and a blower for applying a current of gas to each coated article to dry it.

3. In an automatic coating machine, the combination of, a conveyor for a plurality of articles to be coated, a spray gun for applying an atomized jet of coating material to each of said articles in succession, a nozzle for limiting the application of said jet to each of said articles in one direction by impinging a current of gas on said jet after said jet has been atomized and at a point closer to said article than to said spray gun, a blower for applying a jet of gas to said coated article, and means for rotating the article undergoing coating.

4. In an automatic coating machine, the combination of, means for conveying a plurality of articles to be coated, a spray gun for applying an atomized jet of coating material to each of said articles in succession, a nozzle for limiting the application of said jet to each of said articles in one direction by impinging a current of gas on said jet after said jet has been atomized and at a point closer to said article than to said spray gun, a blower for applying a current of gas to said coated article, and means for rotating the article undergoing coating.

5. In an automatic coating machine, the combination of, means for conveying a plurality of articles to be coated, a spray gun for applying an atomized jet of coating material to each of said articles in succession, nozzle for limiting said jet in one direction on said article by impinging a current of gas on said jet after said jet has been atomized and at a point closer to said article than to said spray gun, and means actuated by pressure operated means, a hood surrounding the coated portion of said article during the coating and blowing operations.

6. In an automatic coating machine, the combination of, means for conveying a plurality of articles to be coated, a spray gun for applying an atomized jet of coating material to each of said articles in succession, outlet means for limiting the application of said jet to said article in one direction by impinging a current of gas on said jet after said jet has been atomized and at a point closer to said article than to said spray gun, and means for applying a current of gas to said coated article to dry it.

7. In an automatic coating machine, the combination of, means for conveying a plurality of articles to be coated, pressure operated means for applying an atomized jet of coating material to each of said articles in succession, outlet means for limiting the application of said jet in a plurality of directions by impinging a plurality of currents of gas on said jet in different directions after said jet has been atomized and at points closer to said article than to said spray gun, and means for applying a current of gas to said coated article to dry it.
8. In an automatic coating machine, the combination of, means for conveying a plurality of articles to be coated, a spray gun for applying an atomized jet of coating material to each of said articles in succession, a nozzle for limiting the application of said jet to said article in one direction by imparting a current of gas on said jet at an angle thereto after said jet has been atomized and at a point closer to said article than to said spray gun, pivotedly mounted means actuated by each of said plurality of articles in succession controlling said spray gun and said nozzle, and adjustable means for adjusting the location of said spray gun and said nozzle in a straight line relative to each other and relative to the portion of said article to be coated.

9. In an automatic coating machine, the combination of, means for conveying a plurality of articles to be coated, a spray gun for applying an atomized jet of coating material to each of said articles in succession, a nozzle for limiting the application of said jet to said article in one direction by imparting a current of gas on said jet at an angle thereto after said jet has been atomized and at a point closer to said article than to said spray gun, means for adjusting the position of said spray gun and said nozzle in a straight line relative to each other and relative to the portion of said article to be coated, and means for adjusting vertically the portion of said article to be coated relative to said spray gun and said nozzle.

10. In an automatic coating machine, the combination of, means for conveying a plurality of articles to be coated, a spray gun for applying an atomized jet of coating material to each of said articles in succession, a nozzle for limiting the application of said jet to said article in one direction by imparting a current of gas on said jet at an angle thereto after said jet has been atomized and at a point closer to said article than to said spray gun, means synchronized with the movement of said means for conveying, and control means actuated by each of said articles in succession and interposed between said cam means and the operating elements of said spray gun and of said nozzle for controlling the actuation of said spray gun and said nozzle by said cam means.

11. In an automatic coating machine, the combination of, a dial for conveying a plurality of tubes, a plurality of tube holders mounted on said dial, a spray gun for applying an atomized jet of coating material to each of the tubes carried by said tube holders in succession, a nozzle for limiting the application of said jet to said tubes in one direction by imparting a current of gas on said jet at an angle thereto after said jet has been atomized and at a point closer to said tube than to said spray gun, operating means for rotating said tube holders during the operation of said spray gun, and pivotally mounted means actuated by each of said tubes in succession controlling the operation of said spray gun and said nozzle.

12. A process of coating articles which comprises in combination, applying an atomized jet of coating material to a portion of each of said articles in succession, simultaneously limiting in one direction the application of said jet to said article by imparting a current of gas on said jet after said jet has been atomized and at a point closer to said article than to the point of origin of said jet, and subsequently drying said coated article by a current of gas.

13. A process of coating a plurality of articles, which process consists in applying an atomized jet of coating material to a portion of each of said articles in succession, simultaneously limiting in one direction the application of said jet to a portion of said article in a plurality of directions by imparting a plurality of currents of gas on said jet after said jet has been atomized and at points each closer to said article than to the point of origin of said jet, and drying said coated article by applying a current of gas to said coated portion.

14. A process of coating a plurality of articles, which process consists in, applying an atomized jet of coating material to a portion of each of said articles in succession, and simultaneously limiting the application of said jet to said article in one direction by imparting a current of gas on said jet after said jet has been atomized and at a point closer to said article than to the point of origin of said jet.

15. A process of coating articles, which process consists in, applying an atomized jet of coating material to a portion of each of said articles in succession, and simultaneously limiting in one direction the application of said jet to said article by imparting a current of gas on said jet after said jet has been atomized and at a point closer to said article than to the point of origin of said jet, and subsequently drying said coated article by a current of gas.

16. A process of coating an article which comprises in combination, applying an atomized jet of coating material to a portion of said article, simultaneously limiting in one direction the application of said jet to said article by imparting a current of gas on said jet after said jet has been atomized and at a point closer to said article than to the point of origin of said jet, and subsequently drying said coated article by a current of gas.

17. A process of coating the upper, open end of a cylindrical tube, which process comprises, simultaneously applying a jet of coating material to the inner and outer surfaces of the open end of a tube, and simultaneously limiting in one direction the application of said jet to the outer surface of said tube by imparting a current of gas on said jet at sufficient velocity to deflect the particles of coating material forming said jet.

18. An automatic coating machine comprising in combination, a base, a prime mover mounted on said base, a conveyor for a plurality of tubes mounted on said base, means for driving said conveyor from said prime mover, a plurality of tube holders mounted in said conveyor, a spray gun mounted on said base for applying a jet of coating material to each of said tubes carried by said tube holders in succession, a nozzle mounted on the base for imparting a current of gas on said jet at an angle thereto for limiting the application of said coating to the tube in one direction, means for adjusting said spray gun and said nozzle on said base horizontally relative to that portion of said tube which is to be coated, means for adjusting said conveyor so that the tubes carried thereby are vertically disposed on said base relative to said spray gun and to said nozzle, and means actuated by each of said tubes in succession controlling the operation of said spray gun and said nozzle.

19. In an automatic coating machine, the combination of, means for conveying articles to be coated, a spray gun for applying an atomized jet of coating material to each of said articles in succession, means for conveying said articles in succession, a means for applying an atomized jet of coating material to each of said articles in succession, and means for controlling the application of said jet to said article by a current of gas on said jet after said jet has been atomized and at a point closer to said article than to the point of origin of said jet, and subsequently drying said coated article by a current of gas.
jet of coating material to each of said articles in succession, and a nozzle independent of and adjustable separately from said spray gun, said adjustment being relative to the jet of coating material and to the article being coated, said nozzle having an outlet orifice wider than said jet for limiting the application of said jet to said article in one direction by impinging a current of gas on said jet after said jet has been atomized.

20. In an automatic coating machine, the combination of, means for conveying articles to be coated, a spray gun for applying an atomized jet of coating material to each of said articles in succession, and a nozzle having an outlet orifice sufficiently wide to provide a current of gas at least equal in width to the width of said article for limiting the application of said jet to said article in one direction by impinging said current of gas on said jet after said jet has been atomized.

21. In an automatic machine for coating collapsible tubes, the combination of, means for conveying tubes to be coated, a spray gun for applying an atomized jet of coating material to each of said tubes in succession, and a nozzle mounted for adjustment in a straight line intermediate of and independent of said tube and said spray gun, said nozzle being arranged to limit the application of said jet to said tube in one direction by impinging a current of gas on said jet at a sufficient velocity to deflect the particles of coating material forming said jet.

22. A process of coating tubular articles having open ends, which process comprises, applying an atomized jet of coating material to the outer and inner surfaces of the open end of the article, impinging a current of gas on said atomized jet after said jet has been atomized and at a sufficient velocity to deflect the particles of coating material in said jet and to thus form a sharp line of demarcation between the coated and uncoated portions of the article being coated, and simultaneously rotating the article being coated so as to produce a uniform coating around the open end both inside and outside.

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