

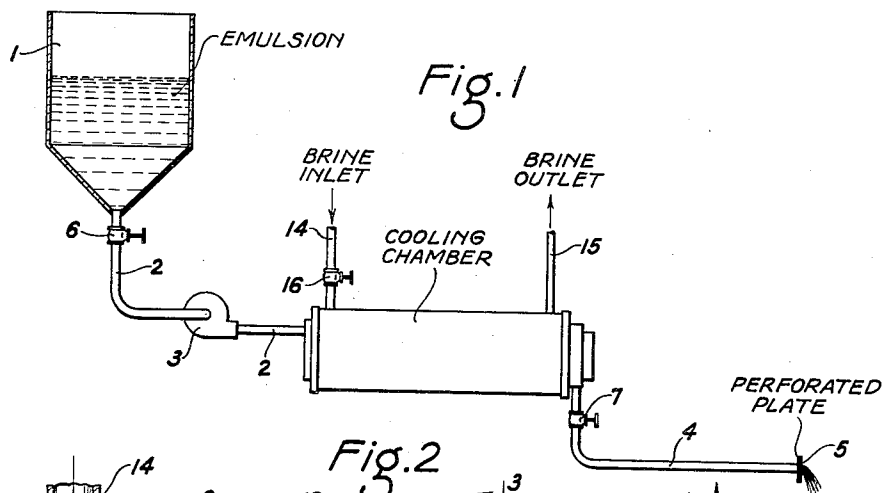
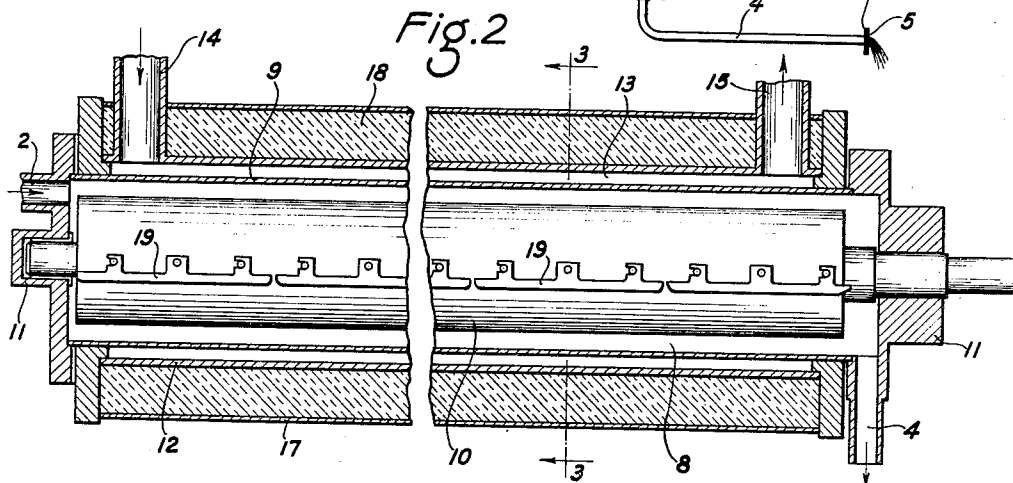
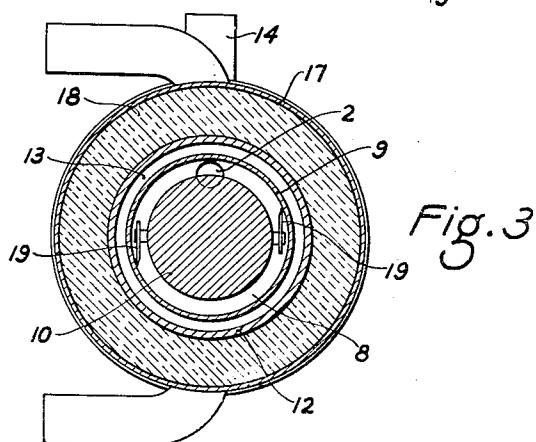
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METHOD OF CHILLING PHOTOGRAPHIC EMULSIONS

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METHOD OF CHILLING PHOTOGRAPHIC EMULSIONS

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This invention relates to a method of chilling photographic emulsions, and has for its object to improve the quality of the emulsion by a practical, economical and efficient method for rapidly, uniformly, and progressively chilling it preparatory to shredding and washing, thereby materially enhancing the coating together with the quality of the finished product and at the same time greatly reducing the time required for processing the emulsion and substantially lowering the cost of manufacture.

Photographic emulsions such as herein contemplated generally include gelatin, silver halides, and a considerable quantity of water, the usual practice having been to chill the emulsion in a large pan that is cooled by contact with cold brine or an alcohol solution which in turn is cooled by pipes through which brine is passed, but such procedures have required considerable time to reduce the entire mass of emulsion to a sufficiently low temperature to cause its solidification owing to the thickness of the emulsion body in the pan and the difficulty in chilling all portions of it, and it is a particular purpose of the invention to subject a photographic emulsion to the necessary chilling temperature while it is in a relatively thin film and at the same time is being continuously stirred and moved along over the cooling surface at a fast rate so as to chill the emulsion quickly and uniformly throughout, while maintaining its rate of travel over the cooling surface and the temperature of the cooling medium above such points as will cause formation of ice crystals from the water in the emulsion.

Another object of the invention is to provide a practical and economical method for rapidly and uniformly chilling a photographic emulsion which usually contains approximately ninety percent water and ten percent solid, without crystallization of the water, since the formation of crystals in the emulsion would render it unsuitable and destroy its value as a light-sensitive coating.

A further purpose of the invention is to afford a method for rapidly, uniformly, and continuously chilling photographic emulsions, accomplishing in a few seconds what has heretofore required hours with conventional old procedures, and which can be carried out economically with a practical, simple and relatively inexpensive apparatus.

Still an additional purpose of the invention is to unite the chilling, solidifying, and shredding of the emulsion into a single continuous opera-

tion, instead of slowly hardening it in stationary containers and thereafter shredding in a separate operation as heretofore, and thereby enabling quick chilling and solidification of a photographic emulsion and its discharge in shredded form suitable for washing or remelting.

To these and other ends, the invention consists in the steps and procedure that will appear clearly from the following description when read in conjunction with the accompanying drawing, the novel features being pointed out in the claims following the specification.

In the drawing:

Fig. 1 is a diagrammatic view of one form of apparatus with which the method can be successfully practiced commercially;

Fig. 2 is a longitudinal vertical sectional view through the cooling chamber, and

Fig. 3 is a transverse vertical sectional view of the same.

The invention may be carried out in various ways with different types of mechanism, and for purposes of illustrating a practical form of apparatus for effecting the desired result, there is shown herein a tank 1 to receive the photographic emulsion which generally consists of from five to ten percent gelatin, from two to ten percent silver halides, and approximately eighty to ninety percent or more water. The photographic emulsion is supplied to the tank 1 in liquid or molten state at a temperature of preferably 95° F., or from 90° F. to 100° F., to be solidified or set and shredded preparatory to the usual washing and remelting operations.

The photographic emulsion is conducted from tank 1 through a pipe 2 by means of a suitable high pressure pump 3 and thereby forced through the cooling chamber from which it is conducted under pressure by pump 3 through the outlet pipe 4 leading from the cooling chamber, and thence through a perforate plate 5 from which the shredded or noodled emulsion is collected in a suitable container or receptacle. If desired, the outlet pipe 4 and perforate plate 5 might be omitted in which case the chilled emulsion can be solidified and shredded in any other preferred manner after leaving the cooling chamber. The valves 6 and 7 are provided in the inlet and outlet pipes 2 and 4 respectively for controlling the passage of the emulsion as desired.

The photographic emulsion is forced through the cooling chamber while being stirred in a thin film which is preferably annular and from one-quarter inch to one and one-half inch in thickness, thus enabling extremely rapid and uni-

form chilling of the emulsion by subjecting all parts of it to the cooling action and moving it rapidly through the cooling chamber. This is accomplished by an annular cooling chamber 8 formed between a surrounding cylindrical wall 9 and a central cylindrical stirring shaft 10 that is mounted in bearings 11 and may be rotated continuously in any suitable way at a speed of approximately 600 R. P. M. more or less.

Surrounding the cylindrical wall 9 and spaced therefrom is a cylindrical wall 12 affording a brine or coolant chamber 13, while 14 and 15 designate inlet and outlet pipes communicating with the coolant chamber for conducting a supply of brine, ammonia liquor, or other cooling medium continuously therethrough, 16 being a valve located in the brine inlet 14 for controlling the same. The brine chamber 13 is surrounded by an outer wall 17, and 18 designates insulating material located between the outer wall 17 and the cylindrical wall 12 of the brine chamber.

19 designate scraping units carried by the central stirring shaft 10 and arranged for engagement with the surface of the surrounding wall 9 of the cooling chamber. As the shaft is rotated, the scraper units 19 engage the wall 9 to prevent the emulsion from adhering thereto and also impart a continuous stirring action to the emulsion, which being in a relatively thin film within the cooling chamber and continuously stirred is uniformly subjected throughout to the action of the coolant passing through the coolant chamber 13 and acting upon the emulsion through the surrounding cooling surface 9.

It is essential to proper conditioning of the emulsion that it be solidified or set without the formation of ice crystals which would spoil the emulsion, rendering it unfit for photographic purposes, and it has been discovered that by chilling and setting the emulsion very rapidly in contrast with the slow hardening processes heretofore employed, it is possible to obtain a light-sensitive coating that gives a faster photographic speed and markedly better contrast or gradation than the coatings as heretofore manufactured.

This result can be obtained with varying temperatures of the brine or other coolant and with various rates of speed of the emulsion. It has been ascertained that successful results are had by maintaining the brine or coolant at a temperature of approximately 12° F. and forcing the emulsion through the cooling chamber at a rate of approximately one and one-quarter inches per second, which chills the emulsion to a temperature of from 28° F. to 30° F., although the temperature of the coolant and the rate of movement of the emulsion may be varied to suit conditions. This process effects very rapid chilling of a photographic emulsion, reducing its temperature to the required extent in a comparatively short time but without permitting the formation of crystals from the water in the emulsion.

The photographic emulsion is in a somewhat liquid state as it leaves the cooling chamber, depending upon its rate of travel and temperature of the coolant, and may be handled in any desired way for shredding, preparatory to washing or remelting, but it can be set or solidified in a continuous operation immediately after leaving the cooling chamber by forcing it under the pressure of the pump 3 through the outlet conduit 4, which for practical purposes may be about

three feet in length and have an inside diameter of three-quarters inch.

While travelling through the pipe 4, the emulsion is not stirred or chilled so that it becomes solidified by the time it reaches the outlet from pipe 4, at which point it is forced through a perforate plate 5 or otherwise formed into a multiplicity of fine noodles or shreds and received in any container or receptacle for subsequent washing and remelting as well known in the art.

With a process such as described involving rapid and uniform chilling of a photographic emulsion, the photographic quality of the coating is materially improved, the photographic speed is faster, and a better contrast or gradation is obtainable from a paper coated with such emulsion than with photographic papers coated according to previous practices. Owing to the speed and efficiency of the chilling process as compared with the much slower procedures heretofore employed for photographic emulsions, it is possible to chill the emulsion uniformly in a few seconds to an extent that required hours with former methods, thus both facilitating and reducing the cost of manufacture in addition to obtaining a markedly superior product.

While the invention has been described with reference to a particular procedure and structure, it is not limited to the exact details disclosed, and this application is intended to cover such departures or changes as may come within the purposes of the improvement or the scope of the following claims.

I claim:

1. The method which consists in rapidly, uniformly, and progressively chilling a molten photographic emulsion containing water, gelatin and silver halides by forcing it under pressure in a thin film through a cooling chamber while stirring the emulsion and maintaining its temperature and rate of travel above the points at which crystallization of the water in the emulsion takes place.

2. The method which consists in rapidly, uniformly, and progressively chilling a molten photographic emulsion containing water, gelatin and silver halides by forcing it under pressure in a thin annular film over a cooling surface surrounding said film while stirring the emulsion and maintaining its temperature and rate of travel above the points at which crystallization of the water in the emulsion takes place, and continuously solidifying the emulsion by forcing it from said cooling surface through a conduit of relatively small diameter.

3. The method which consists in rapidly, uniformly, and progressively chilling a molten photographic emulsion containing water, gelatin and silver halides by forcing it under pressure in a thin film through a cooling chamber while stirring the emulsion and maintaining its temperature and rate of travel above the points at which crystallization of the water in the emulsion takes place, continuously solidifying the emulsion by forcing it from the cooling chamber through a conduit of relatively small diameter, and shredding the solidified mass as it emerges from said conduit.

4. The method which consists in rapidly, uniformly, and progressively chilling a molten photographic emulsion containing water, gelatin and silver halides by forcing it under pressure in a thin annular film over a cooling surface surrounding said film while stirring the emulsion and maintaining its temperature and rate of

travel above the points at which crystallization of the water in the emulsion takes place, continuously solidifying the emulsion by forcing it from the cooling surface through a conduit of relatively small diameter, and shredding the solidified mass as it emerges from said conduit.

5. The method which consists in rapidly, uniformly, and progressively chilling a molten photographic emulsion containing water, from five to ten percent gelatin and from two to ten percent silver halides, by forcing it in a thin film under pressure through a cooling chamber at a rate of approximately one and one-quarter inches per second while stirring the emulsion and cooling it to a temperature of approximately 28° F. to 30° F. without crystallizing the water in the emulsion.

6. The method which consists in rapidly, uniformly, and progressively chilling a molten photographic emulsion containing water, from five to ten percent gelatin and from two to ten percent silver halides, by forcing it under pressure in a thin annular film over a surrounding cooling surface at a rate of approximately one and one-quarter inches per second while stirring the emulsion and cooling it to a temperature of approximately 28° F. to 30° F. without crystallizing the water in the emulsion, continuously solidifying the emulsion by forcing it from the cooling surface through a conduit of relatively small diameter, and shredding the solidified mass as it emerges from said conduit.

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