May 28, 1963 H. L. CLEMENT ETAL 3,091,109

CIRCULATING SYSTEM FOR CARPET DYE BECKS

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FIG. 2.

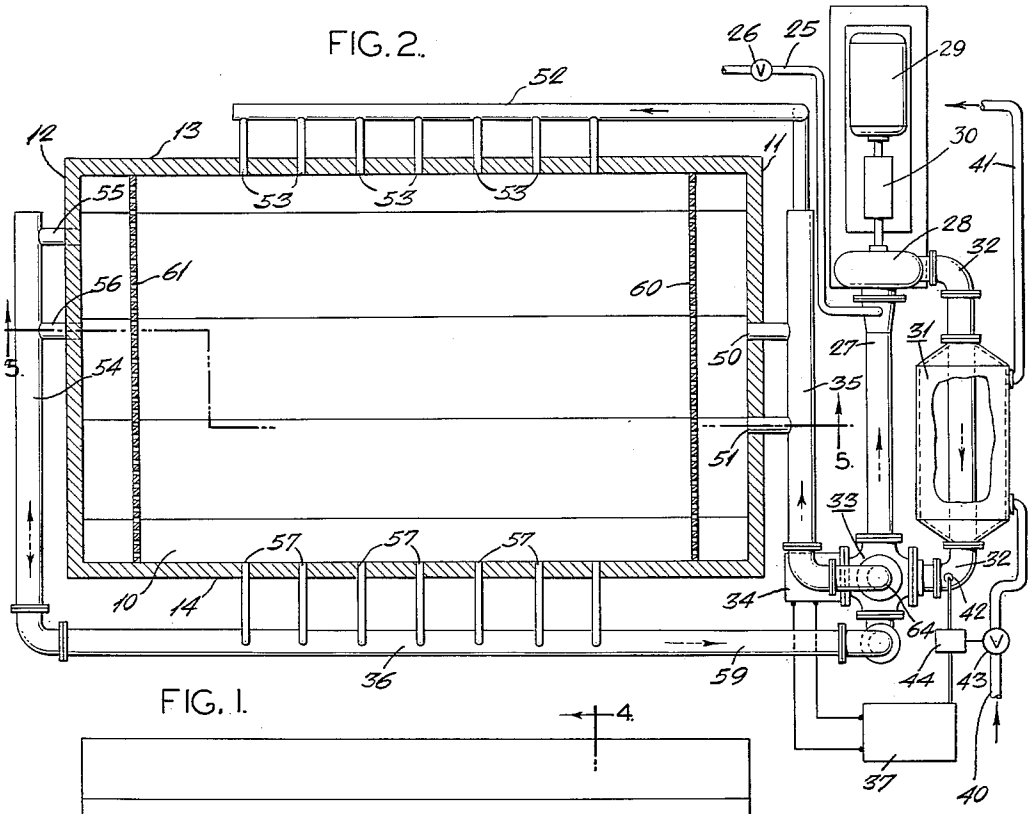
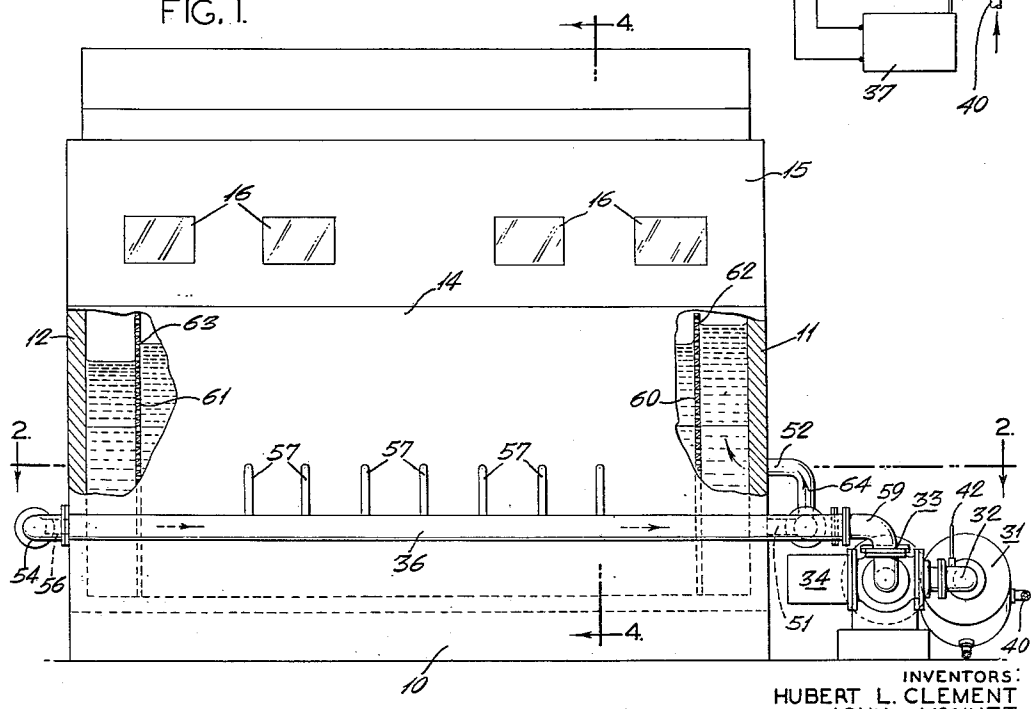


FIG. 1.



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FIG.3.

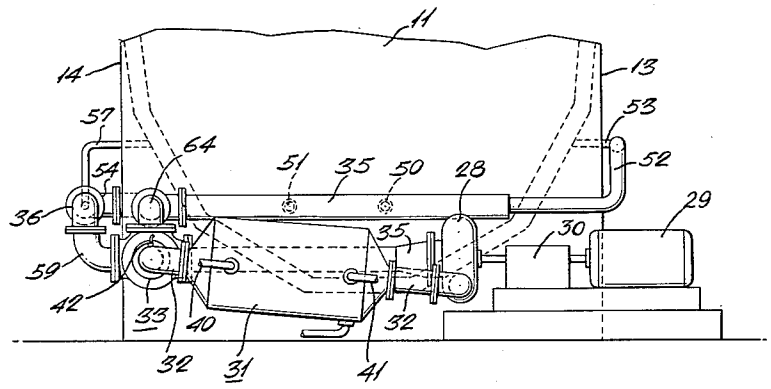
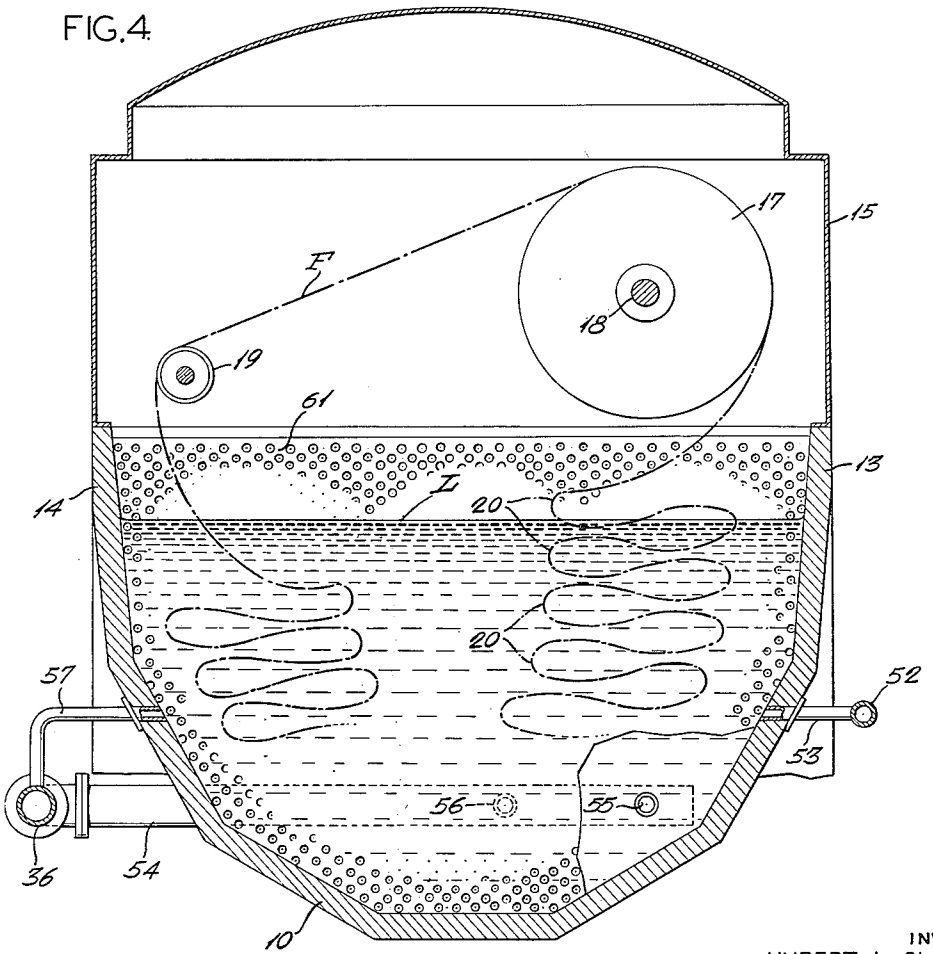


FIG.4.



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FIG.5.

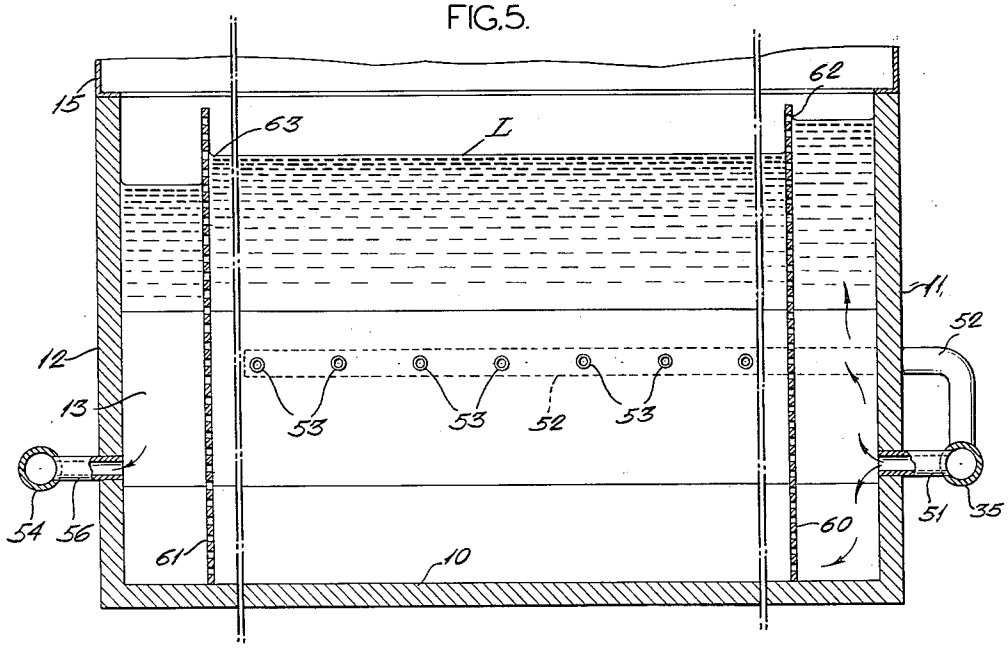


FIG.6.

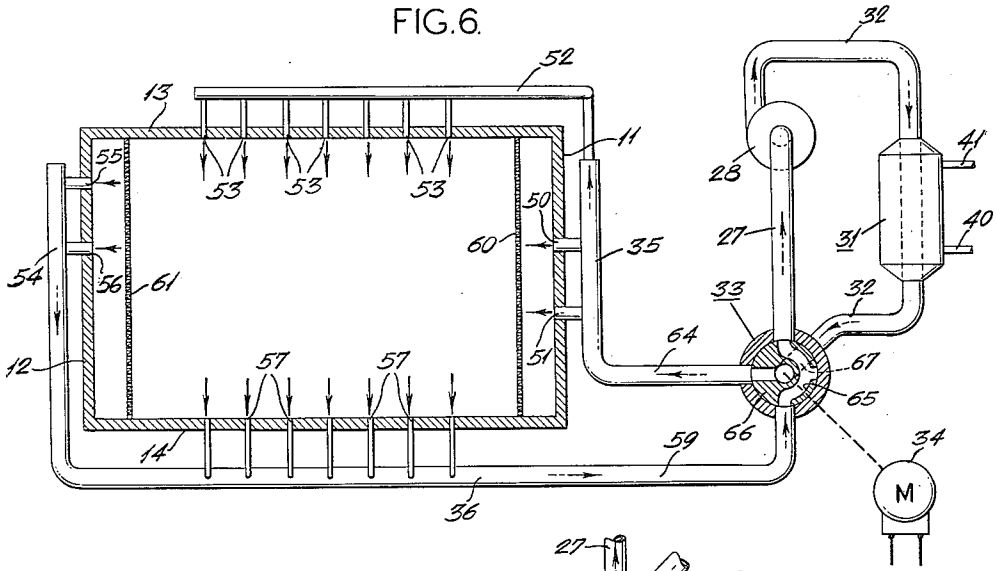
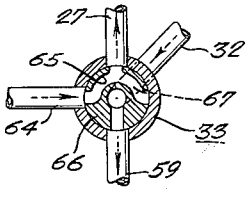


FIG.7.



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CIRCULATING SYSTEM FOR CARPET DYE BECKS

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Filed Sept. 28, 1960, Ser. No. 59,061
5 Claims. (Cl. 68—177)

This invention relates to dyeing apparatus and more particularly to an improved dye kettle for piece dyeing of fabrics such as carpets and rugs.

Although many types and varieties of dye kettles for pile fabrics have been used and proposed in the past, none of these has been free from serious disadvantages. Some of the objections to past construction were the inability to achieve uniformity of dye concentration within all areas of the kettle and also to maintain such uniformity for extended periods of time or even for the time required to completely dye one piece of fabric. The control of heat and liquor concentration is extremely critical in the case of some dyes and dilution from the introduction of steam condensate proved to be a serious disadvantage. Efforts to construct a completely satisfactory dye kettle have heretofore baffled expert engineering talent, not only in the carpet industry, but in the segment of industry which customarily builds and supplies equipment of this type. By way of example, it would ordinarily be supposed that both dye and acid uniformity could be maintained by means of mechanical agitators and/or impellers. When this was tried, however, it developed that the excessive agitation rendered the pile fabric unacceptable. Contact with the dye kettle components caused felting of the pile and consequent rejection. Other expedients which were tried with unsatisfactory results were increasing the dye cycle, but this introduced serious disadvantages due to dilution and inability of the chemical agents to maintain uniform properties during the lengthened dye cycle. It then became apparent that the shorter the dye cycle, the better would be the quality of the fabric, since the fabric would be subjected to a minimum of physical contact with the spreader, reel, and the interior surfaces of the kettle. It must be appreciated that the average loading of a carpet piece dye kettle comprises from 120–150 yards of carpet. The essence of the present invention is the result of much experimentation and trial and error in the design of these dye kettles and the results in some regards were unexpected since they were contrary to what was thought to be the best practice.

By providing high volume, reversible liquid flow, and by utilizing the shortest practical dye cycle, it was found that the fabric is subjected to one-fourth to one-sixth of the frictional contact with structural elements of the dye kettle. High uniformity and control of temperature, dye distribution, and acid distribution are also obtained. The particular manner in which the liquids are introduced into and discharged from the dye kettle is also important in providing uniform flow and dye concentration throughout the interior of the kettle without agitation of the fabric. Automatic and accurate devices provide excellent control of temperature and heat distribution, particularly in the shortened cycle. The volume of liquid circulated in the present invention is approximately 400% greater than in any known previous construction. All dilution of the liquor is eliminated thus maintaining uniform values throughout the cycle. Overhead intake and discharge lines in previous kettles were found unsatisfactory due to non-uniform distribution and excessive agitation which in some instances has caused the carpet to float on the liquor instead of to follow its proper overlapping path. The use of the terms "liquor" and "dye liquor" herein is intended to include all liquids introduced during

the complete treatment of a piece of fabric. Included are the usual rinsing, scouring, and setting operations, all of which take place in the "dye" kettle.

In brief, the primary object of the present invention is to provide an improved dye kettle for piece dyeing lengths of pile fabric measuring to 150 yards in length and 15 feet in width which does not injure the fabric and which provides controlled uniform dyeing.

A further object of the invention is to provide a dye kettle having a quick cycling reversible flow on the order of 1500–1800 gallons per minute together with means for reducing the mechanical agitation of the fabric caused by the high volume travel of the fluids through the kettle.

Further objects will be apparent from the specification and drawings in which:

FIGURE 1 is a front elevation partly broken away showing a piece dye kettle constructed in accordance with the present invention,

FIGURE 2 is a sectional view as seen at 2—2 of FIGURE 1,

FIGURE 3 is a detailed side view of the liquid handling mechanism as shown in FIGURES 1 and 2,

FIGURE 4 is a section as seen at 4—4 of FIGURE 1,

FIGURE 5 is a section as seen at 5—5 of FIGURE 2,

FIGURE 6 is a schematic flow diagram, and

FIGURE 7 is a schematic detail of the reversing valve showing the position of the valve in a reversed portion of the cycle.

A dye kettle of the type to which the present invention is applied comprises a base **10**, two vertical ends **11** and **12**, a back **13**, and a front **14**. As is customary, a cover or lid **15** having a plurality of windows **16**, **16** may be put in place during the operation of the mechanism. As seen in FIGURE 4, a length of fabric such as a piece of woven pile carpeting F is trained over a drum **17**, mounted on and driven by a shaft **18**, and a roller **19** which may be designed to maintain proper alignment of the fabric in the kettle. The fabric falls in folds **20** on the bottom of the kettle and is in turn picked up from the folds during the process of the dyeing or treating cycle. In general, the complete dye cycle includes the operations of scouring, rinsing, and dyeing. The first two operations require extremely accurate and uniform control of the various ingredients in the particular baths.

The liquid baths including the dye liquor are introduced to the system through a conduit **25** controlled by a valve **26**. These liquids are discharged into the suction or intake line **27** of a high volume centrifugal pump **28** driven by an electric motor **29** and equipped with a liquid cooled bearing **30**. Pump **28** discharges into a heat exchanger **31** through conduit **32** and from thence to and through an automatically controlled four-way valve **33** which is reversed by means of suitable motor control mechanism **34** to connect the discharge conduit **32** successively to a manifold or header **35** for the first part of the cycle and then to a manifold or header **36** for the reverse portion of the cycle. This cycling operation is under control of an automatic timing device contained in the control box **37** and per se forming no part of the present invention. The time cycle is chosen for the particular amount and type of fabric being treated but is ordinarily on the order of several minutes.

Accurate temperature control is achieved by means of a steam inlet line **40** connected to the heat exchanger **31** and from which steam and/or condensate is discharged through line **41**. A temperature sensitive element **42** is positioned in discharge conduit **32** which in turn controls steam valve **43** through a temperature responsive mechanism **44**.

When valve **33** is positioned as shown in FIGURES 1

and 6, the liquid, whether it be a dye liquor or a scouring bath, flows through header **35** and into and through the side **11** of the dye kettle through ports **50** and **51**. The header **35**, however, is provided with an extension conduit **52** which terminates in a secondary header having in the present instance seven discharge ports **53**, **53** which introduce liquid along the length of the back **13** of the dye kettle as shown in FIGURE 6. It will be noted that the ports **53** as well as all the other ports are positioned below the normal liquid level L in order to reduce to a minimum undesired agitation of the fabric folds **20**.

Liquid from the dye kettle is supplied to the pump **28** and intake conduit **27** through a header **54** having ports **55**, **56** on opposite end **12** of the kettle and which are not in alignment with ports **50** and **51**. Liquid is also discharged from the kettle through a series of ports **57**, **57** in the front **14** of the kettle which are connected to header **36** and thence to valve **33** by means of conduit **59**. The lateral alignment of the ports **53** and **57** has been found to be less critical than is the case with ports **55**, **56** and **50**, **51** since liquid flowing from end to end in the kettle travels transversely through the folds rather than longitudinally and thus the opposite location of the ports provides more even flow in this direction.

To further control and improve the lateral or end-to-end distribution of the liquids, we provide perforated baffles **60** and **61** adjacent each end of the kettle spaced from, but parallel to the end walls **11** and **12**. There will be a slight relative differential in the liquid level on the intake and discharge sides with respect to the liquid level L in the kettle. This difference is shown at **62** and **63** in FIGURE 1. During the various parts of the cycle, such scouring, dyeing, and rinsing, timing mechanism **37** energizes the control motor **34** to reverse valve **33** whereupon the liquid is supplied to conduit **59** and headers **36**, **54**. On this reverse cycle, liquid flows from the kettle through headers **52** and **35** and thence into intake line **27** through valve **33**. This cycle is shown schematically in FIGURE 7 in which the intake conduit **27** is connected to conduit **64** and header **35** through a passage **65** in the valve barrel **66**. Likewise conduit **32** is connected to conduit **59** through a passage **67** in the valve barrel. Rotation of the barrel 90° reverses the flow so that suction line **27** is connected to conduit **59** through passage **65** and discharge line **32** is connected to conduit **64** through passage **67**. This latter position of the valve is shown in FIGURE 6.

It will be understood that we have therefore provided an improved circulation system for dye kettle liquids in which the cycle has been reduced to a minimum time, undesirable agitation and frictional contact of the fabric is reduced to a minimum, and uniformity of liquid ingredients both as to constituency and temperature is accurately maintained.

Having thus described our invention, we claim:

1. A piece dye kettle for the liquid treatment of pile fabrics and the like which comprises a liquid reservoir having side walls and end walls, a series of ports positioned in said side walls and end walls and substantially below the normal liquid level in the kettle, a header connected to said ports, a first liquid conduit connecting all of the ports on one side and one end, a second liquid conduit connecting all of the ports on the opposite end and opposite side, a high volume liquid pump, a motor for driving said pump, a third intake liquid conduit connected to said pump, a dye liquor intake conduit connected to said third intake liquid conduit, a fourth discharge liquid conduit connected to said pump, a heat exchanger in said discharge liquid conduit, and a four-way valve connecting all four of said conduits.

2. Apparatus in accordance with claim 1 having automatic control means for reversing the conduit connections through said valve.

3. Apparatus in accordance with claim 1 having a perforated baffle positioned in the kettle parallel to each of said end walls and spaced therefrom.

4. Apparatus in accordance with claim 1 in which the ports in the ends are offset with respect to each other across the kettle.

5. Apparatus in accordance with claim 1 including a steam line for introducing steam into the heat exchanger, a temperature sensitive element in the fourth discharge conduit from the pump, a valve in said steam line, and means responsive to said temperature sensitive element for operating said valve to control the temperaure in the fourth discharge conduit from the pump.

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