No. 688,742. Patented Dec. 10, 1901.

H. LAAG, C. RÜTLER & M. RUTLER.

PROCESS OF DYEING.

(Application filed May 28, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

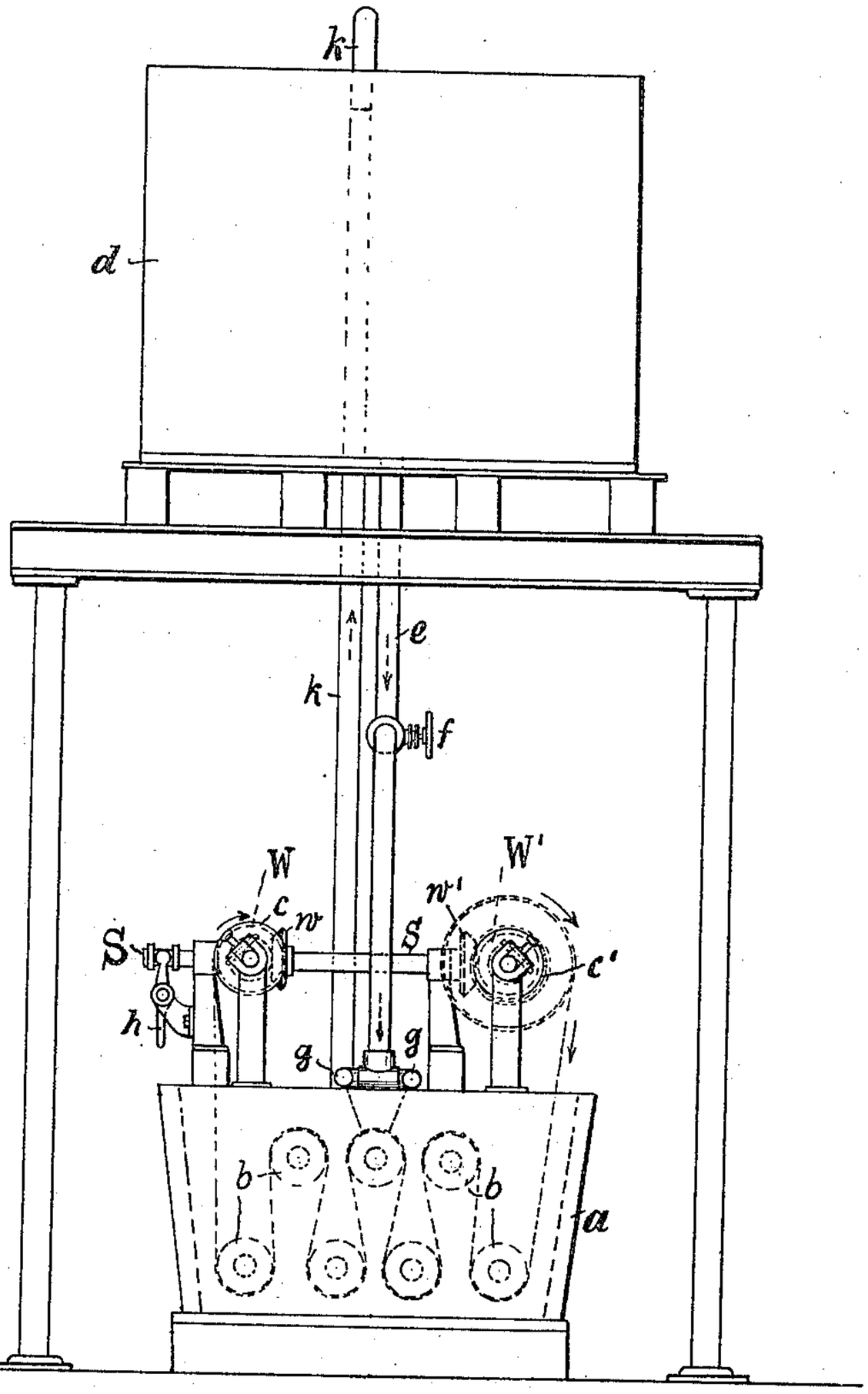

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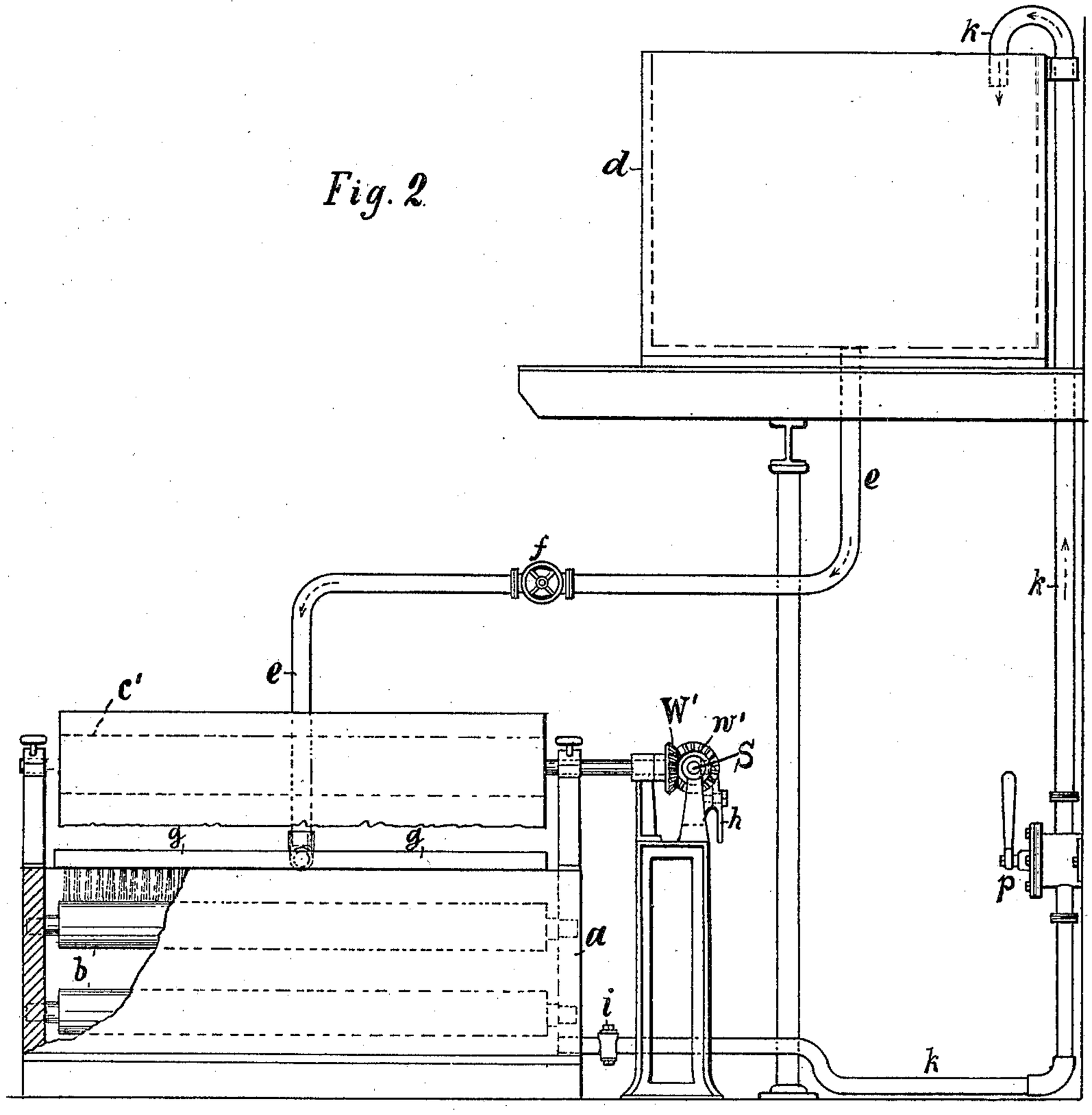
Fig. 2.



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UNITED STATES PATENT OFFICE.

HEINRICH LAAG, CHARLES RÜTLER, AND MARTIN RUTLER, OF DUSSELDORF, GERMANY.

PROCESS OF DYEING.

SPECIFICATION forming part of Letters Patent No. 688,742, dated December 10, 1901.

Application filed May 28, 1898. Serial No. 682,050. (No specimens.)

To all whom it may concern:

Be it known that we, HEINRICH LAAG, CHARLES RÜTLER, and MARTIN RUTLER, residents of Dusseldorf, Germany, have invented certain new and useful Improvements in Piece-Dyeing; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

Since the introduction of piece-dyeing of silk fabrics and fabrics of half silk and half cotton the method followed of treating the pieces on the reel or in a wincing or other machine has always involved various kinds of injury to this fabric, and although with time these injuries have been reduced by greater experience and care in the treatment, the practical abolition thereof is still to be desired. At the present time the defects and injuries which are still caused by the primitive lengthy manipulation of the fabric on the reel or in the wincing-machine, &c., and through the handling with the dyeing-sticks are so serious that they are the very despair of the dyer as well as of the customer.

The faults or defects caused by dyeing on the reel or in other machines hitherto employed are essentially the following: first, irregular penetration of the dye; second, lack of uniformity in appearance and breaks in the fabric; third, general wearing away of the silk threads, and consequently diminished gloss and reduced strength of the fabric; fourth, streaks which are caused by a longer treatment than the ordinary, this being necessary for pieces which in the first treatment are not sufficiently dyed or are not finished according to sample; fifth, entirely worn-through whitish-gray places, the result of careless and unskilful handling of the dyeing-sticks or friction on the reel or the like; sixth, cracked strips or streaks in which the dye material has taken more strongly; seventh, visibility of the sewing-holes at the longitudinal sides of the fabric, which are caused in tacking the pieces together in order to protect the silk side, and, eighth, the pieces are so badly damaged at both ends by tying the pieces to one another or binding them together by means of their ends that the loss caused thereby to the manufacturers amounts, in pieces of one hundred meters long, to at least three-fourths per cent. and in pieces of fifty meters long to one and one-half per cent. of the value of the goods. The occurrence of these faults could be avoided by adopting the "jigger" dyeing process; but all efforts to dye in colors perfectly by means of this jigger process have been quite unsuccessful. That process has not heretofore succeeded in dyeing the pieces uniformly. In employing the jigger filled with the dye-bath it was found that the fabrics, especially fabrics with great affinity for the dyestuff, such as silk and half-silk fabrics, during the running through such a jigger took up the dyestuff from the bath very rapidly, and the fabric at the commencement of the roll was very much more strongly dyed than toward the middle or the end thereof. By employing friction mechanism in the jigger to control the speed of travel of the fabric or by allowing the pieces to pass frequently to and fro, adding each time a suitable amount of dyestuff, and also by adding dyestuff from time to time during the running through of the fabric, it has been possible in some degree to lessen the difficulties. Heretofore, however, no one has been able to sufficiently obviate them so as to obtain certainty in dyeing, especially for silk or half-silk fabrics, so that the reel or the wincing-machine, &c., is still preferably employed at the present time.

By the present invention we have devised a simple process in order to overcome this inconvenience incident to the ordinary jigger dyeing process and are enabled to employ the latter with good results for dyeing fabrics, even fabrics of threads, which take up the dye very rapidly. We have found that this can be done by moving the fabric through the jigger-vat with increasing velocity while introducing a previously-prepared dye-bath into the vat of the said jigger in such a manner that the latter is gradually filled, not before, but during the moving of the fabric through this vat. Furthermore, not only the

gradual filling of the jigger-vat with the dye-bath during the movement (with increasing velocity) of the fabric through the said vat, but also this filling of the jigger-vat, must be with a dye-bath which possesses such composition and such a strength that a given area of the fabric to be dyed receives the desired color and shade directly by means of a given volume of the said dye-bath, thereby exhausting this volume of its dyeing power.

The subject-matter of the present invention consists, therefore, in a process of dyeing fabrics by previously preparing the dye-bath in a quantity, composition, and strength adapted as such (*i. e.*, only by the ingredients originally contained therein) to produce the desired shade of the intended coloration on the whole area of the said fabric, thereby practically exhausting this dye-bath, and then traversing the fabric through the vat of a suitable dyeing-machine (*i. e.*, of a jigger) with increasing velocity and during this traversing gradually introducing, practically without interruption, this whole bath into the vat of the jigger, in such a manner that this vat is gradually filled with the dye-bath during the traversing of the fabric through the vat, and by traversing the fabric through the vat so often until the dye-bath in the jigger-vat is sufficiently exhausted, whereby the fabric receives the desired shade of the intended coloration.

The construction of a jigger which is adapted for carrying out the present invention is shown in the accompanying drawings, in which—

Figure 1 is an end elevation of a construction of apparatus which may be used in carrying out our invention, and Fig. 2 is a side elevation with a part of the vat broken away.

The jigger-vat *a* has mounted in bearings at its upper part two drums *c* and *c'*, the former having a bevel-wheel W and the latter a bevel W'. A driving-shaft S carries two bevel-wheels *w* and *w'*, the former to gear with the wheel W and the latter with the wheel W'; but they are so spaced and the shaft S can be so moved longitudinally by a handle *h* that when the wheels W *w* are in gear the wheels W' *w'* are out of gear, and vice versa. Rotary motion can thus be imparted either to the drum *c* or the drum *c'* from the shaft S.

In the drawings the drum *c* is shown as being driven in the direction indicated by an arrow and as rolling up the fabric from the drum *c'*, which is thereby revolved in the direction shown by the corresponding arrow. By moving the handle *h* the wheels *w w'* can be brought, if desired, in such position as to revolve the drum *c'* in the opposite direction, so as to roll up the fabric from the drum *c*. The fabric is guided on its to-and-fro motion between the drum *c'* and the drum *c* through the jigger-vat *a* by means of the guiding-rollers *b b*. Above the jigger-vat a reservoir *d*, containing the dye-bath previously prepared, is arranged. A pipe *e*, having a valve *f*, leads the dye liquid from the said reservoir *d* to the jigger-vat and has two branch pipes *g g*, perforated on their length, so that the dye liquid flows as a fine spray onto the fabric. The exhausted dye liquor may be returned after the dyeing process by means of a pipe *k*, having a cock or valve *i* and pump *p*, from the jigger-vat to the reservoir *d*, whereupon it may be employed for preparing a new dye-bath.

From the above it will be seen that the jigger is a dyeing-machine by which the fabric is led through the dyeing or jigger vat in an unfolded state alternately in one direction and in the opposite one by rolling up the fabric from drum *c'* (being in this case the rolling-off drum) onto another drum *c* (being in this case the rolling-up drum) directly revolved by a driving mechanism—as, for instance, by wheels—and then after moving the handle *h* by likewise rolling up the fabric from drum *c* onto drum *c'*, so that in this case the drum *c'* serves as the rolling-up drum now directly rotated by the wheels and the drum *c* as rolling-off drum.

Since the axial velocity of the drum directly rotated remains the same and during the rolling up of the fabric the diameter of the drum increases, the velocity of travel of the circumferential points increases, and consequently the velocity of the travel of the fabric through the bath must increase, which is important for the success of and intended by the present process.

It may be stated that the direction of motion of the fabric can be reversed in the well-known manner by transposition of the gear for the rolling-up drum, or in case where, for instance, only one gear exists, such as in other dyeing apparatus, by transposition of the rolling-up drum itself.

In beginning the dyeing process the jigger-vat is first empty. The introduction of the dye-bath into the jigger takes place simultaneously with the beginning of the running of the fabric through the vat. Also before the beginning of the process the jigger-vat can be filled with the dye liquor to such a height that the lower guiding-rollers are in contact with or laved by the liquor, and then afterward, while the fabric is kept in motion, the whole quantity of the dye-bath can be gradually introduced. The danger of an ununiform dyeing of the material, particularly in the beginning of the dyeing, will in this case, however, still exist. Therefore it is preferable to begin the process at first with an empty jigger.

The gradual introduction of the whole quantity of the dye-bath previously ascertained to be necessary should be done in a practically continuous manner. Single interruptions when not too important may occur in some cases with a practically sufficient result; but even those will decrease the chances of success. This introduction of the dye is preferably effected in such a manner that the dye

liquor is squirted or sprayed out of the reservoir by means of squirting-pipes, rose-heads, or the like onto the fabric while the latter is traveling through the jigger. The dye liquor having been in contact with the fabric and therefore weakened in its content of dyestuff collects in the lower part of the jigger and rising always higher in the further operation can more and more lave the fabric, running through and further dye the same without, however, thereby causing any want of uniformity of coloration of the fabric. The reason is this: By increasing the velocity of the travel of the fabric the duration of contact of the latter with this dye-bath (which would be increased in consequence of the rising of the level of the dye-bath caused by the flowing in of the liquid into the jigger-vat) is correspondingly reduced or shortened, thus obtaining a practically uniform action upon the whole fabric. By this method of operation a uniform action of the dye upon the fabric and full penetration of the dyestuff into the fabric are obtained, so that the fabric after the flowing in of the dye liquor is finished and without fresh supplies of dye can be passed to and fro through the bath to obtain the necessary depth of shade and the desired penetration of the dyestuff into the fabric.

By the present process it is intended to directly obtain the desired shade of color without further addition of dyestuff during the dyeing operation. In proceeding, as described, by traversing the fabric through the vat and by introducing the previously-prepared dye-bath into the vat so that the dye-bath rises gradually higher in the vat during the time the fabric runs through the same with increasing velocity a uniform coloration of the fabric in the desired shade of the intended coloration results. For this purpose it is only necessary to prepare previously the bath to be employed in a strength or composition corresponding to the desired shade of the intended coloration, (*i. e.*, preliminary, intermediate, or definitive coloration,) so that one unit of volume of this bath without further addition of the dyestuff gives the desired (preliminary, intermediate, or definitive) color to a definitive unit of quantity according to the surface or to the weight of the fabric, whereby this unit of volume of this bath is exhausted of its dyeing power.

The preparation of the dye-bath can be effected in any manner. The following is, however, preferred by way of example: Assuming that the fabric to be dyed has a length of one thousand meters and a width of sixty centimeters and that the dye-bath possesses a volume of one thousand liters—that is to say, there is one cubic centimeter of the dye liquor for six square centimeters of the fabric—a sample of the size of one hundred and twenty square centimeters, for example, will be thoroughly dyed in twenty cubic centimeters of an approximately prepared liquor while maintaining the same temperature as employed for the actual dyeing. If the depth of shade is now not yet sufficient, a corresponding amount of dyestuff is added and it is again tested, this being repeated until the desired shade is obtained.

The practical carrying out of the process has fully proved that by the present invention the above-mentioned faults and injuries are obviated.

We claim as our invention—

1. The process herein described of dyeing fabrics, consisting in previously preparing the dye-bath in a quantity, composition and strength sufficient at least for the whole length of the fabric to be dyed, then supplying said dye-bath gradually to the fabric, at the same time feeding the fabric with a gradually-increasing velocity through the dye-bath so supplied, and gradually and simultaneously increasing the quantity and raising the level of the said dye-bath through which the fabric is being passed, until the whole length of the fabric has been dyed, substantially as set forth.

2. The process herein described of dyeing fabrics, consisting in previously preparing the dye-bath in a quantity, composition and strength sufficient at least for the whole length of the fabric to be dyed, then supplying said dye-bath in a spray to the fabric, at the same time feeding the fabric, at a gradually-increasing velocity, through the dye-bath so supplied, and gradually and simultaneously increasing the quantity and raising the level of the said dye-bath through which the fabric is being passed, until the whole length of the fabric has been dyed, substantially as set forth.

In testimony that we claim the foregoing as our invention we have signed our names in presence of two subscribing witnesses.

HEINRICH LAAG.
CHARLES RÜTLER.
MARTIN RUTLER.

Witnesses:
WILLIAM ESSENWEIN,
W. B. PETTIT.