Dam'ask, a textile fabric, the ground of which is bright and glossy, with vines, flowers, and figures interwoven. At first it was made only of silk, but afterward of linen and woolen. According to the opinion of some, this kind of weaving was derived from the Babylonians; according to others, invented at a later period by the inhabitants of Damascus, from which latter place it is known to have derived its name. The true damasks are of a single color. In modern times the Italians and Dutch first made damask; and Europe was supplied, as late as the 17th century, from Italy alone, chiefly from Genoa. But the French soon imitated it, and now surpass the Italians. Damask is made in great quantities in Germany, chiefly in Upper Lusatia. Dunfermline is the chief seat of the manufacture of damask linen in Scotland, and Lisburn (q.v.) and Ardoyne in Ireland.

Damask Designing and Manufacture. To trace the origin of the art of weaving, or to ascertain the name of the artisan whose necessities led him to devise the crude appliance capable of being used in the production of even the very coarsest woven material, would be a hopeless task indeed, separated, as we are, from a period so exceedingly remote by the impenetrable gloom and obscurity which must ever enshroud the events of three or four score centuries ago. And yet we are safe in assuming that the ability to produce woven fabrics by means of a loom, no matter how elementary in construction, far antedates all written history, carrying us back to those early ages when the first rays of the sun of progress were faintly discernible above the horizon of time, awakening within our humble ancestors the desire for those things, which when obtained served to lighten their toil, and at the same time form part of the foundations of the noble structure, to which successive generations have contributed their share, and which we call civilization.

Coming down to a later period, however, we are enabled to gather authentic information regarding the degree of progress made in the art of weaving. Trustworthy records dating as far back as 2000 B.C. reveal the fact that the weavers of ancient Egypt were far advanced with the production of plain woven fabrics, many excellently preserved fragments of fine linen, which have been taken from the mummy cases of that period, testifying not only to the reverence with which they regarded the embalmed remains of their illustrious dead, but also to their skill and proficiency as weavers.

In the Bible also we find numerous references to the products of the loom. Job speaks of his days as being swifter than a weaver's shuttle (Job vii. 16). We also read that the draperies of the tabernacle and the veil of the temple were woven fabrics, richly embroidered with various colors. These allusions to the art of weaving, and others too numerous to mention, are scattered profusely throughout the pages of the sacred volume; while heathen writers of antiquity frequently allude to weaving as an art which was held in the highest esteem, and which furnished a favorite occupation for people representing every grade of society, from those who dwelt in the marble halls of princes down to the occupants of the most humble dwellings.

Nor was skill in weaving confined to one locality or people; an art so essential to the comfort and welfare of humanity at large, must speedily have become the common property of widely separated races; consequently we find that the Babylonish weavers of the year 1000 B.C. were celebrated for the richness and quality of their woven fabrics; while at the same period the patient Hindu and the stolid Chinese were producing fabrics of the finest texture on looms of the most primitive description.

From this it is obvious that the ancient races were familiar with the principles of fabric construction, and that they were able to produce a considerable variety of elementary weaves by using different varieties and counts of yarn in combination with each other; yet there is nothing to show that they were acquainted with any form of loom, the mechanism of which made possible the production of intricate floral or ornamental designs, such for example as could easily have been woven on the draw loom of a later period, or by its successor, the highly improved Jacquard power loom of the 20th century. This obvious drawback, however, they endeavored to overcome by means similar to those employed

by modern manufacturers of textiles, who, in order to meet the demand for showy and inexpensive fabrics of a certain description, are accustomed to arrange either the warp or filling in the form of a series of stripes of contrasting colors, harmoniously arranged together or else by changing the color of both warp and filling at such intervals as a previously devised pattern indicates, are enabled to produce an extensive variety of checkered patterns.

Designs of this character the weaver of ancient times found no difficulty in creating, but any large ornate or floral patterns with which he was familiar, were obtained either by printing, or the skill of the embroiderer, or when considered desirable, a combination of both added to the woven material after it had passed from his hands, and which as a result cannot be classed with those fabrics, which, produced entirely on the loom, are valuable on account of the elaborate nature of the designs with which they are embellished, as much as by the costliness of the materials employed in their construction.

It will thus be seen that a loom which could only be used in the production of a comparatively restricted variety of designs was sure to be superseded sooner or later by one of a more highly developed type, which would allow the decorative instinct of the early textile artist greater oportunity to express the ideas suggesting themselves to him.

In due time a loom capable of accomplishing these results was invented, probably in China, where, like so many other relics of the long forgotten past, it may be seen in operation at the present day, although long since consigned to the rubbish heap in all progressive countries.

From China the draw loom, as it came to be called, found its way to other parts of the globe. But it remained for the weavers of the ancient city of Damascus, the capital of Syria, to develop the possibilities of the new loom to the utmost extent, with the result that in time they established a large manufacturing and export trade in the beautiful silken fabric which soon became widely known as damask, taking its name from that of the city to which for centuries it brought wealth and renown, and in the manufacture of which the Damascene excelled all competitors.

In regard to the fabric itself, it and various other weaves, now passing under the same name, will be analyzed and described farther on, but any detailed description of the now thoroughly obsolete draw loom would be out of place and of no value to the average reader, but those desirous of making a thorough study of the subject will find their curiosity gratified by consulting the excellent treatise on hand loom weaving by Murphy, published during the early part of the 19th century.

Stated as briefly as possible, however, it may be said that the draw loom tie-up was a compound arrangement, one part of the harness being controlled by a lad known as the draw-boy, the other part controlled by shafts for the purpose of subdividing the warp, so as to form the fine ground weave peculiar to damask fabrics. Just as the weaver was about to throw the shuttle across the lathe, the warp, of which there may have been five, six, seven, or more ends to each mail, according to the quality of damask desired, was raised *en masse* by the draw-boy in accordance with the requirements of a previously painted pattern, all the remaining warp being left down. The shuttle would thus have passed under the warp raised and over the warp left down without interlacing or forming cloth, had it not been for the supplementary arrangement of harness shafts, through which the entire warp was drawn, for the purpose of enabling every end to be used separately.

For each pick one of these shafts would be raised and one depressed, the others remaining undisturbed, the shaft which had been raised lifting every eighth end from among the mass of warp left down, the shaft which had been depressed carrying down with it every eighth end from the mass of warp raised, while the shafts which remained in a neutral position were so constructed as to permit the lifting of one portion of the warp and the sinking of the remainder as called for by the design, without interfering with the shed or passage of the shuttle. By this means the pattern was formed and the warp and filling interwoven so as to produce an eighth shaft satin or any similar weave required.

During the wars of the Crusades the draw loom, along with many other things Oriental, found its way into various European countries, thereby aiding greatly the development of weaving as applied to silk damask, brocade, velvet, and other fabrics; the great artists of the Middle Ages not considering it beneath their dignity to supply the necessary designs for these rich textiles. For centuries, however, the draw loom remained practically the same as when first introduced, but in the year 1604 a Frenchman named Simblot devised a method by means of which the draw-boy was enabled to raise the warp while standing at the side of the loom, instead of the top, as had been the custom previously.

In England also, during the 17th and 18th centuries, patents were taken out for several devices intended to render the services of the draw-boy unnecessary; these, however, soon passed from public view, but the draw-boy remained, toiling away at his monotonous task for many a day after the mortal remains of Jacquard had crumbled to dust.

In the United States the manufacture of the finer grades of silk and cotton damask and upholstery fabrics in general is of comparatively recent origin, the vast majority of looms devoted to this industry being located in Philadelphia, with lesser numbers scattered throughout New York State, New Jersey, Connecticut, and Virginia.

Twenty-five years ago the business was in its infancy, but "mighty oaks from little acorns grow," and to-day the manufacture of upholstery goods is one of the most important industries of the country, which, with allied trades, such as yarn-spinning, dyeing, and the manufacture of textile machinery, provides the means of livelihood for tens of thousands of operatives, and at the same time is a standing monument to the business enterprise of the American manufacturer. Nor have we by any means reached the limits of our development in this direction; the remarkable inventive ingenuity of the American artisan, which in many other lines of business has practically placed him beyond the reach of competition, will not be likely to fail him when applied to the weaving industry.

Silk Damask Curtain. Designed by William Laird Turner. Exhibited by the Philadelphia Textile School at the Chicago World's Fair. 210 ends per inch. 120 picks per inch. Pattern on design paper covered 174 square feet. 28,320 cards required to form the design on cloth, which placed end to end would extend a distance of 7¾ miles. The largest pattern designed in the United States, up to 1893.

DAMASK MANUFACTURE

We will now consider the machine which time and experience has clearly demonstrated to be the most valuable contribution to the art of ornamental pattern weaving yet devised, and which owes its usefulness to the ingenuity of Joseph Marie Jacquard (an artisan of Lyons, France, born in the year 1752), although a large share of the honor bestowed on Jacquard is really due several others who endeavored during the early part of the 18th century to improve the draw loom. M. Falcon, for example, in the year 1728 invented a method of raising the warp by means of a chain of cards, on which a pattern was represented by holes perforated thereon, the cards being adjusted to a square cylinder also perforated to match a fully punched card. M. Vaucanson is also entitled to credit for improving the cylinder and causing it to revolve and move backward and forward with the cards. He also invented the griffe, which had for its object the raising of the warp; but these inventions, although constituting the essential features of the Jacquard machine, never passed beyond the realm of experiment until about the year 1801, when profiting by the experience of his predecessors after careful study of the problem, Jacquard introduced the machine which bears his name, and revolutionized the art of weaving.

The Jacquard machine may be defined as a piece of mechanism placed above a loom for the purpose of raising warp in any possible order a previously designed pattern may indicate.

The framework is of iron, strongly built, in order that the various parts may stand the strain to which they are subjected during the process of weaving. The steel hooks or wires which raise the warp are placed in an upright position, the needles occupying a horizontal position. Every needle is connected to a hook in such a manner that when the needle is pressed back by a card the hook is carried back also. A spring at the end of each needle sends both hooks and needles back to their original position. Each hook has a crook at the lower as well as the upper end. To the crook at the lower end the harness cords are fastened, and at the lower end of the harness cords the heddles are attached. In the centre of each heddle a small metal eye called a mail is fastened. Through the eye of the mail the warp is drawn. Below each heddle an iron weight called a lingo is attached for the purpose of keeping harness cord, heddle, mail, and warp in the proper position.

An important part of the machine is called the griffe. It is an oblong iron frame containing as many strips of iron called the bars, or knives, as there are rows of hooks lengthways in the machine. Each of these bars rests directly under the upper crooks of the hooks. The griffe has a rising and falling motion. When it moves upward it raises all the hooks whose upper crooks rest directly above the bars or knives, allowing those hooks which have been pushed aside by the card to remain down.

Another important part of the machine is the cylinder, on which the cards are carried backward and forward, to and from the points of the needles when the loom is in operation. It has four sides, each side being perforated with as many holes as there are needles in the machine, or holes in a fully punched card.

To control the movement of the hooks a pattern is painted on squared design paper. If it is to be woven by means of a 400 machine the designer cannot use more than 400 small squares from right to left on design paper; or, if the pattern is to be woven by a 600 machine, he cannot exceed 600, or 1,200 if made to suit a 1,200 machine, unless he makes use of hooks belonging to two extra rows, with which Jacquard machines are usually furnished. Neither is he compelled to use the full number of hooks available, as the pattern may be subdivided into two, four, six, or any number of parts required, but it would be necessary to paint out the full extent of the design unless the first part could be reproduced on an even number of rows, in which case the card stamper would go over the part painted as often as necessary, in order to indicate the complete number of harness cords on the card.

When the pattern has been completed it is given to the card stamper, who punches holes in the cards wherever the design indicates that warp is to be raised.

When the cards have all been cut they are laced together in regular rotation and placed upon the cylinder, around which they revolve in an endless chain. The loom is then started, and the cylinder carrying the cards with it moves toward the needle points, against which they are pressed. Where no holes have been punched, the card forces the needles back. The needles carry the hooks with them out of the way of the griffe bars, which rise at the same moment. This allows the warp to remain down, resting on the shuttle race, but where holes have been punched in the card, the needles enter, allowing the hooks to remain undisturbed, their upper crooks resting directly over the griffe bars, which, when rising, lift hooks, harness cords, and warp, forming a shed through which the shuttle passes.

From this it will be evident that to raise warp, holes must be punched in the card, and where warp is to be left down, the card must be left uncut. The Jacquard machines generally used in the manufacture of upholstery fabrics range in capacity from 624 to 2,608 hooks. Within recent years a new machine known as the fine index Jacquard has come rapidly into favor. It is more accurately built than the older type known as the French index machine, and contains 80 full rows of 16 holes, and 24 extra holes on the peg hole rows, or a total of 1,304 holes on one card, a little larger than a 624 hook French index card.

For weaving fine damask goods, the machines generally used are known as double lift, single cylinder Jacquards, while manufacturers of such fabrics as turkey red damask table covers, use the double lift, double cylinder machine; another Jacquard called the rise and drop machine is also much used by upholstery goods manufacturers, these Jacquards being operated at a considerably higher speed than is obtainable with an ordinary straight lift, single acting machine.

In the double lift single cylinder machine, for example, there are double the number of hooks contained in a single lift Jacquard of the same capacity; although each has the same number of needles, there are also two griffes which work alternately, thus enabling the loom to be driven at a higher rate of speed, each griffe and the hooks it controls coming into operation at

each alternate pick only, thereby avoiding unnecessary friction of both machine and warp.

In the double lift, double cylinder Jacquard, the pattern cards are divided into two sets, all odd-numbered cards being placed on one cylinder, and evenly numbered cards on the other. When the loom is in operation the cylinders come into play alternately, the odd cards and cylinder for the first pick, the even cards and cylinder for the second pick, and so on, each cylinder working at the rate of about 70 picks per minute, or 140 for both.

In addition to these machines there are a considerable variety of other makes adapted or modified to suit special conditions. The twill Jacquard, for example, designed to weave fine damask and other fabrics requiring a great number of warp ends with a machine of small hook capacity, the Jacquard in this case weaving both figure and ground, thereby greatly reducing the cost of designing and card-stamping. The cross border Jacquard is the name given to another style of double cylinder machine used for weaving table covers and border fabrics. In this case the cards for weaving the border are placed on one cylinder, and those forming the centre on the other, each cylinder being called into action to weave its own part of the pattern only.

Other varieties of machines might be mentioned, but those already referred to are sufficient to show that a Jacquard machine which might be perfectly adapted to a certain class of work would probably be of little use for anything else.

The «tie-up» is the technical term applied to the method by which the various harness cords controlling the warp are connected to the hooks of the machine, in order to form the elaborate patterns required for Jacquard woven fabrics in general.

The tying up may be accomplished in the three following ways: (1) By what is termed the straight tie method; (2) by the point or centre tie method; and (3) by those two methods in combination.

When the harness is tied up so that each end in the warp is controlled by a separate hook, it is known as a straight through single tie, which, for designing purposes is the best possible arrangement of the harness cords, as it enables the designer to execute a pattern extending from selvage to selvage without being compelled to repeat any portion unless found desirable. This method of tying up is rarely ever used, however, unless for narrow fabrics, or large panels woven in imitation of Gobelin tapestry, on account of the great expense it would necessarily involve for designing and card stamping, the manufacturer finding it much more economical to use the straight repeated tie, or the point tie, by means of which he could weave with a 1,200 machine, a damask or tapestry curtain, for example, containing 9,600 warp ends, in the full width of the fabric, by tying up the harness so that the pattern would be repeated eight times, to accomplish which the comberboard would require to be separated into eight equal divisions, each containing 1,200 holes and the same number of harness cords, the first cord from each division being connected to the first hook, the second cord from each division to the second hook, the third cord from each division to the third hook, and so on, so that by raising any particular hook eight warp ends would be lifted, one from each division, all forming a portion of the design exactly alike, each in its own division.

From this it will be evident that the number of times a pattern may be repeated in the width of the fabric depends upon two things. In the first place, upon the number of hooks which the machine contains, and in the second place, upon the texture of the fabric to be produced, the finer the texture the greater the number of hooks necessary, in order to form a wide repeat.

The second tie-up referred to, the point, or centre tie, is generally adopted when the manufacturer desires a larger and more imposing style of design than is obtainable with the ordinary straight repeated tie.

For example, by using a 600 machine tied up straight, so as to give a warp texture of 100 ends per inch, the width of one repeat of the pattern would be limited to six inches, but by tying up the same number of ends per inch, using the point or centre tie method, the width of one repeat of the pattern would be 12 inches, and the number of harness cords and warp ends 1,200, controlled by 600 hooks.

This tie-up has one disadvantage, however, as it can only be used in the production of designs which are symmetrical, or alike on both sides of a line drawn from top to bottom, in the centre of the full repeat. In regard to the arrangement of harness cords for curtains, table covers, etc., for which this tie-up is much used, the first hook in the Jacquard machine is generally made to control two harness cords in the exact centre of the comberboard, the last hook controlling two harness cords, one of which is at the extreme left, and the other at the extreme right of the comberboard.

The combined point and straight tie is used principally for curtains, table covers, couch covers, and other fabrics requiring side borders, this method being adopted because the pattern repeat can be increased thereby. For fine weaves, however, a machine more limited in capacity than a 1,248 hook French index, or the 1,304 hook fine index Jacquard, will hardly be found serviceable, the 600 machine restricting the designer to very small patterns, which, while cheapening the cost of production a trifle on that account, and because fewer cards are required, would still be unprofitable, as the woven product could not compete with goods of the same texture ornamented with larger and more imposing designs; however, for cheap fabrics, such as turkey red damask, the 600 machine is commonly used, with the harness tied up to give a straight tie centre and a point tie border, with a warp texture of from 60 to 70 ends per inch, finished goods.

In medium grade fabrics the warp generally varies between 90 and 100 ends per inch, the 1,248 or 1,304 hook machine giving a curtain 50 inches wide, containing 4 straight repeats of 1,200 ends each, equal to 96 ends per inch, but as a curtain without a border is more or less unfinished, the machine could be used to greater advantage by dividing the hooks into two parts, the first 600 tied up point tie in three 12½ inch repeats, and the second 600 tied up straight, so as to give two borders, each six and a quarter inches wide, by which means the full width of 50 inches would be secured.

For the finest fabrics where extensive single scale patterns are necessary, larger machines must be used, but if the cost of production must be reduced to a minimum, compound harness shafts may be used, with as many ends to each mail as are necessary to obtain the desired result.

When tying up has been completed, the loom is then ready for the warp, which for cotton damask and similar fabrics is generally delivered at the mill by the cotton spinner, undyed, and in chain form, spun to the counts or number wanted, the length of the chain and the number of ends it may contain varying to suit the requirements of different manufacturers, chains from 500 to 600 yards long and containing 1,200 ends being commonly used for 50 inch wide cotton damask fabrics, with a warp texture of 96 ends per inch, finished goods, a warp of this description requiring four chains, each containing 1,200 ends, in order to make up the full warp of 4,800 ends.

After the warp has been dyed the necessary color, it is sent to the beamer, who begins by taking the ends of the warp containing the pin lease, which he twists around several wooden pins on what is known as the rack, in order to regulate the tension with which it passes around another tension device, composed of three large hollow wooden rollers, or drums, as the beamers call them; the warp is then, by means of the pin lease, passed through the dents of a coarse reed suspended from the ceiling, then distributed over a second fixed reed to the required width, which is usually a little in excess of the width of the warp in the loom reed. Thence it is passed under two iron rollers, the second of which presses the warp down on the beam, causing it to go on firmly; it is then fastened to the beam, and the actual work begun, the beamer standing eight or ten feet from the beam, using the coarse hanging reed already referred to for the purpose of unraveling the warp, and causing it to pass through the fixed reed and on to the beam evenly, great care being exercised in order that all slack, crossed, or broken ends may be adjusted, this being absolutely necessary in order that the weaver may be saved annoyance and loss of time when the warp is in the loom.

The foregoing description applies to warps which can be beamed directly from the chain, but the warp for many varieties of cotton fabrics is not strong enough to stand the friction and strain of weaving, and requires different treatment previous to beaming.

Sea Island cotton, grown in the Fiji Islands, for example, has the longest fibre of any variety, the length of which runs from 1.25 to 1.90 inches, with the American variety of Sea Island cotton a close second, it varying between 1.60 and 1.80 inches, while Texas grown cotton is shorter in staple than any other variety, running between 0.70 and 0.95 inches. From this it will be seen that a single or slack twisted thread will be materially strengthened if coated with some starchy substance, the basis of which may be flour, starch, sago, or any other suitable medium. This is what is done, and the process involved is termed dressing the warp, special machines being required for the purpose.

Cotton, however, is not the only warp so treated. Linen warp for table damask is also dressed before beaming, the object being not only to enable it to stand the friction of weaving, but because by that means the cloth takes on a superior finish, which is one of the desirable features of table damask, and which enhances its value accordingly.

In regard to silk, the most beautiful and costly yarn employed in the manufacture of textiles, it is extensively used both as warp and filling, in the finest grades of silk damask and brocades.

As it comes from the cocoon, or covering with which the silk-worm protects itself when in the chrysalis stage of its existence, it is too delicate to have any commercial value, but during the process of reeling four, five, or six threads are taken from as many cocoons and formed into one fine continuous thread, called singles, the reeling being accomplished by placing the cocoons in warm water, which softens the natural gum they contain and binds the group of separate strands into a single thread.

Tram silk is the name by which reeled silk filling yarn is known, two or more singles being loosely twisted together for that purpose.

Organzine is the name given to reeled silk warp yarn. It also is formed with singles, twisted separately, then doubled and twisted again, thus forming a remarkably strong and brilliant thread.

Spun silk is also in great demand for fine damask warps. It, however, has not the brilliancy of reeled silk, being formed with cocoons which have been pierced, or otherwise spoiled, and which, along with the refuse and waste accumulating during the reeling process, is torn up, then carded, and spun to the counts or number desired.

In regard to the warping and beaming of silk, it may be said that organzine and spun silk warp used in the fine silk damask trade, is bought in skein form, and in the gray, which, after being dyed, is wound on large bobbins, then transferred to the warping mills in sections, the creel on which the bobbins are placed not being large enough to hold all the bobbins necessary for the completion of the entire warp at one operation. After the warp has been put on the mill it is wound around the beam; when this is finished it is taken charge of by the twister, whose duty it is to twist the ends of the new warp to the corresponding ends of a short length of the old one which has been left in the loom for that purpose; but in the case of a new tie-up, or any change in the arrangement of the mails, which occurs when a straight tie for single warp fabrics is altered to suit a two or three warp weave, without cutting down the harness, the old warp would require to be taken out of the loom, and the new warp drawn through the mails and reed as required. before being ready for weaving.

Wool, jute, ramie, and other yarns are also used in the manufacture of damask fabrics, but the foregoing description will furnish a general idea of the warping, beaming, and twisting operations involved.

The next thing to be considered is the designing of patterns for Jacquard fabrics, this subject being one of vital importance to the manufacturer of high class ornamental textiles, the prosperity or decline of a business of this character depending in a great measure on the artistic ability of those responsible for each season's patterns.

Those unfamiliar with textile designing will probably imagine that the creation of new pat-

terns lies entirely with the designer, which to a certain extent is true, but, generally speaking, the designer is the medium through which the ideas of the mill owner, manager, salesman, or other supposed expert find expression. If this important work is performed by a man of refined taste, in close touch with the trade, and always on the lookout for novel ideas in weave and design, if he is or has been a good original designer, and is familiar with fabric construction, so much the better. The business fortunate enough to possess a man with these qualifications will always secure its share of whatever trade is being done; but, unfortunately for some manufacturers, the designer is looked upon as of no more value to the firm than the man who oils a machine and keeps it running, while the head of the department may recently have been employed as a weaver or card-stamper, who, because of fancied executive ability, has been placed in charge of this important department, with the result that his first thought is to secure the cheapest men on the market, who produce work, which, from lack of proper training, he cannot perceive to be common and devoid of originality, and which, instead of creating dividends, will in time sap the foundations of what might have been, under proper direction, a profitable business.

Among small manufacturers the usual custom is to buy all patterns required from designers who work for the general public, but large concerns as a rule consider it more advantageous to employ a staff of draughtsmen, under the supervision of a head designer, who, in addition to ability as an artist, originator, and colorist, should be familiar with the Jacquard machine, the various methods of tying up, card stamping, and fabric construction. Men with these qualifications are not easily obtained, the technical man as a rule being of no use as an originator, while the designer capable of executing good original work, generally looks with indifference, if not contempt, on the various mechanical operations by which the design is transferred to the cloth, and fails to realize the importance of mastering these details until he finds himself outclassed by one who equals or excels him as an artist, and who, in addition, has burned the midnight oil, in order to acquire the technical knowledge which renders his services valuable.

When the designer is commissioned to prepare a pattern for any of the finer grades of Jacquard fabrics, silk damask furniture covering for example, he first prepares a rough charcoal sketch, drawing the figures the same size as they will appear in the cloth; when satisfied with what he has done, he takes a sheet of tracing paper and goes over the drawing carefully, making the outlines definite, and introducing improvements wherever possible. This carefully drawn tracing is then transferred to a sheet of drawing-paper, on which a background of a suitable color has been previously painted. When this is accomplished, the sketch is painted to resemble the finished cloth, after which it is left for the manufacturer or his representative to decide whether or not it shall be given to the draughtsman to transfer to squared design paper.

On the other hand, some manufacturers consider it a waste of time to prepare a painted sketch, and in the case of designs for many of the coarser grade of textiles, and for one warp one shuttle weaves, such as cotton or linen table damask they are right, a shaded outline sketch being sufficient, but for silk damask and other high grade upholstery fabrics, where fine drawing and careful coloring are essential, a cloth-size painted sketch should always be prepared, not merely as a guide to the draughtsman and colorist, but because it is the only way to secure the best results.

After it has been decided that the sketch may be proceeded with, it is given to the draughtsman to transfer to squared design paper, the simplest and best way to accomplish which is by using the diverging scale, by means of which the sketch may be speedily and accurately ruled into as many squares as there are large squares in one full repeat of the pattern on design paper. Suppose, for example, that the sketch was for cotton damask goods, a 1,200 Jacquard machine being used, the cloth texture being 100 ends warp and 50 picks per inch, 1,200 hooks in one full repeat divided by 100 hooks per inch shows one repeat of the pattern to be 12 inches wide. The design paper necessary for the reproduction of this sketch may be 16 x 8, 12 x 6, 8 x 4, or any paper giving the proportion of 100 ends to 50 picks. Supposing that the draughtsman decided to use 16 x 8 paper, he would ascertain the number of squares into which the sketch should be ruled from left to right by dividing 1,200 by 16, which would give 75, that being the number of large squares in one repeat of the pattern, on design paper. Should this, in his estimation, cut up the sketch into too many squares, he could rule it into half that number, and mark the design paper to correspond.

When the sketch has been squared in this manner, the drawing is copied free-hand from the small squares on the sketch to the larger ones on design papers, this being continued until the whole pattern is reproduced in outline. It is then checked out with colors, representing those on the sketch, although generally brighter and more definite in hue in order that the card-stamper may have no trouble. When this has been accomplished the work of the designer and draughtsman is at an end, and the pattern is given to the card-stamper to be reproduced on the cards.

For a considerable time after the introduction of the Jacquard machine this was one of the most tedious and expensive operations connected with pattern-weaving, the first appliance for perforating the cardboard being simply a common hand-punch used in accordance with the requirements of the design, a second person reading the order of stamping for the guidance of the one who used the punch.

At the present day the cards are stamped by the piano machine, so called because in some respects it is supposed to resemble the musical instrument of that name, the design being placed on a reading-board in front of the stamper, while the keys which control the punches are operated by the fingers, and the card moved along from row to row by means of two pedals, manipulated by the feet. The machines used for stamping damask and other classes of upholstery fabrics are the French index, made to stamp 12 holes to each row, and the fine index, 16 holes to each row, the card guide in these machines being adjustable and self-centring,

so that cards of different widths may be stamped thereon.

Before commencing to stamp from a design similar to that described, the card-stamper would rule the pattern into 100 divisions across, with lines drawn from top to bottom by means of a lead pencil, each of these divisions containing 12 small squares crossways to each line, corresponding to 12 holes in each row on the card, and 12 needles and hooks in the Jacquard machine, and the same number of ends of warp, the full 100 divisions corresponding to the 1,200 hooks forming the tie or repeat of the pattern, and all the various repeats in addition, by which the full width of the woven fabric is made up.

After the design paper has been ruled, the first half, corresponding to the first 600 hooks and ends, is placed in the reading frame and the work of stamping begun, the pattern being read from right to left, from the bottom line upward, each line corresponding to one pick on one-shuttle work, two picks on two-shuttle work, three picks on three-shuttle work, and so on. When both halves of the pattern have been stamped the cards are laced together by hand or machine, this work being generally executed by boys, who, when inexperienced, occasionally make mistakes by turning the cards around, or upside down, and lacing them when thus misplaced.

For example: a 600 Jacquard machine contains 52 full rows of holes, including the 2 extra rows; total, 624 hooks. If the cards are laced in proper rotation, but turned around so that the first hole in each card takes the place of the 624th, the position of pattern on the cloth would be reversed; that is, figures pointing to the right on design paper would point to the left on cloth, and *vice versa.* With some patterns this would make no difference, as for example, a design composed of two-sided figures, each side the reverse of the other, but should the pattern contain a motto, monogram, or initials, as is often the case with linen damask, to reverse the position of the letters would spoil them entirely.

Another mistake which occasionally happens completely destroys the pattern by cutting it into a series of disjointed stripes, running in the direction of the warp, is caused by lacing the cards in correct rotation, but upside down, thus putting the 12th row of holes in the place of the 1st, which, on a 12-row machine, would cause the 1st row of hooks to control the 12th row of harness cords, the 2d row of hooks to control the 11th row, and the 3d row of hooks to control the 10th row, and so on, which, occurring on every card, destroys the pattern in the manner described.

Genuine damask, the weaving of which will now be explained, may be distinguished from other damask fabrics, so-called, by the fact that both ground and figure are eight-shaft satin weaves, the ground formed by the warp and the figure by filling, or *vice versa.*

In the weaving of single-scale fabrics, each hook in the machine controls a separate harness cord, mail and warp end, in one repeat of the pattern, a 1,200 machine tied up to give 200 ends per inch would thus form a six-inch wide pattern, but if each hook were made to control two warp ends of the same counts, the pattern repeat would be extended to 12 inches, or 18 inches if three ends were used, 24 inches if four ends were used, and so on, but as each group of ends is raised by a single hook, the outlines of the pattern are as a result coarser than if each end were controlled separately.

In order to form the fine ground weave it is necessary that the Jacquard harness be supplemented by an arrangement of shafts similar to those referred to when describing the draw loom; these shafts, which are placed between the reed and the Jacquard harness, have heddles containing extra long eyes, or loops, so that when occupying a neutral position the warp may be raised and depressed by the other shafts as the Jacquard harness is raising the warp in a mass to form the design. For example: when weaving a four-scale damask four ends are passed through each mail of the Jacquard harness, after which they are drawn separately through the heddles of the shafts in front, the first end through the first heddle of the first shaft, the second end through the first heddle of the second shaft, the third end through the first heddle in the third shaft, and so on, until the entire warp is drawn in. It will thus be seen that each shaft controls one eighth part of the entire warp and that if they are raised in proper rotation an eight-shaft satin will be formed.

The rising and sinking of these shafts is controlled by that part of the mechanism of the loom called the head motion, acted upon by the harness chain, certain balls called raisers and sinkers being arranged thereon, the raisers to lift and the sinkers to sink the shafts in the order necessary to form the weave, which for an eight-shaft satin may be as follows:

1st	pick	1st	shaft	up,	5th	shaft	down.
2d	"	4th	"	"	8th	"	"
3d	"	7th	"	"	3d	"	"
4th	"	2d	"	"	6th	"	"
5th	"	5th	"	"	1st	"	"
6th	"	8th	"	"	4th	"	"
7th	"	3d	"	"	7th	"	"
8th	"	6th	"	"	2d	"	"

One repeat of the ground weave is thus formed, and by raising and depressing the shafts in the same order for each successive pick the pattern and the exquisite satin weave for which fine damask is renowned, will be produced simultaneously.

The cost of production is greatly lessened by this method of weaving, as 4,800 hooks would be required to weave a pattern which could be produced by a 1,200 hook machine and a four-scale tie-up. It would also be necessary to paint the pattern on 4,800 small squares from right to left on design paper, as against 1,200 required by the four-scale tie, and if a fine index Jacquard is used, four cards would have to be stamped to represent every pick or line on design paper, instead of one as required by 1,200 hooks, thus giving the weaver four sets of cards to look after instead of one, all this additional labor and expense adding nothing to the value of the fabric beyond improving the outline of the pattern somewhat, which, however, for commercial purposes, would not justify the additional outlay, even if wholly practical.

When selecting the requisite design paper for these fabrics it must be remembered that a four-scale damask may contain 200 ends per inch, but as the entire number is controlled by 50 hooks, that number only must be considered. Should there also be 50 picks per inch, 8 x 8,

10 x 10, 12 x 12, or any paper of the same proportion would be suitable. When painting the pattern, red could be used to represent figure, with the ground left white paper, and as the interlacing or stitching together of warp and filling is effected by the shafts, such would not require to be indicated on the design. The stamping of the cards is regulated by the method of weaving, which, in the case of fine silk damask, showing more ground than figure, is usually accomplished with the face of the cloth down, as this lessens the strain on the hooks and also on the lever which raises the griffe. For example: by weaving an eight-shaft satin face up, seven eighths of the warp would be raised and one eighth left down for every pick, but by weaving the cloth face down, one eighth of the warp would be raised and seven eighths left down for each pick, thereby reducing the strain on the machine to a minimum, and at the same time facilitating weaving. The card-stamper would therefore stamp red figure wherever indicated on the design and miss white.

Among the various fine damask fabrics may be mentioned a double-scale one-shuttle weave used principally for upholstering furniture, and which, in the finer grades, is composed of spun silk warp and tram silk filling. In this case each hook controls two ends in every repeat, the Jacquard harness raising both ends as one, while a set of shafts lifts each end separately in order to form the fine satin ground weave. To make this clear, it must be explained that the cloth is woven face down, and that the cards are cut to raise all the warp indicated by the figure painted red on design paper, while the ground warp represented by white is allowed to remain down. From the warp thus left down the shafts raise every eighth end, but as they do not sink any of the warp which has been raised, in order to allow the shuttle to pass under and form figure, the interlacing of warp and filling in the figure part of the fabric must be indicated on design paper, and represented on the card, with the result that at every point of interlacing two ends are left down, except where a shaft happens to lift one when forming the ground weave, but this is purely accidental, as the stitching of the filling by the warp is always done with the object of showing the silk to the best advantage, and while an eighth or sixteenth shaft satin form of stitching could be designed to suit the raising of the shafts, the floating of the silk filling on the face, one of the beautiful features of this fabric, would as a result be destroyed. This class of silk damask is also woven with two and three filling systems, by means of the same arrangement of Jacquard harness and shafts.

When woven with two systems of filling it is known as two-shuttle work, or three-shuttle work when three filling systems are used. When only two colors are used to form the design it is called a two-steady-shuttle pattern, to distinguish it from the same class of damasks in which one shuttle is steadily employed throughout the pattern, while the other is changed from one color to another a number of times in every repeat of the pattern during weaving, thereby cutting one of the filling systems into a series of horizontal stripes of colors, which the skill of the designer must soften and blend into harmony, by proper selection and skilful use of the steady color.

When selecting square design paper to suit a two-shuttle pattern, only half the total number of picks per inch are taken into consideration. For example: a total of 90 picks per inch on cloth would be represented by 45 lines on design paper, but as two cards would require to be stamped to represent the two picks indicated on each line, the full 90 picks per inch are thus made up. In regard to the warp texture, this varies a little, but 180 ends per inch may be considered about correct, and as 180 ends in a double scale tie-up are controlled by 90 hooks the design-paper selected should be in the proportion of 90 ends to 45 picks per inch, 16 x 8, 12 x 6, 8 x 4, or any similar paper would be suitable.

When selecting colors to represent the cloth effect on design paper, yellow may be used to represent the steady shuttle, and red to represent the changing shuttle, it being unnecessary to represent the changes on design paper if a properly executed sketch has been prepared, and also because a change in shuttle is represented by one card only. The background of the pattern should be left white paper, and the stitching on long filling face floats may also be indicated with white, although black or some other color is preferable on account of white having a tendency to peel off.

In this case the cloth would be woven face down, and the cards stamped as follows: First card yellow pick, stamp yellow, miss white, stamp red plain, that is, one end up and one down. Second card red pick, stamp red, miss white, stamp yellow plain.

Analysis of card stamping: First card, yellow pick. Stamping yellow raises all the warp represented on design paper by yellow, and allows the yellow pick to go under and form figure on the face, except where stitching takes place as indicated by white on yellow.

Missing white, allows the warp to remain down in a mass, wherever indicated on the design, except where ends are raised, at regular intervals, by the shafts to form the satin ground weave.

Stamping red plain, raises one half of the warp and leaves the other half down wherever red is indicated on the design, thus forming a plain weave with the yellow pick and the warp on the back of the cloth.

Second card, red pick. Stamping red raises all the warp represented on design paper by red, and allows the red pick to go under and form red figure on the face, except where stitching takes place as indicated by white on red.

Missing white, allows the warp to remain down in a mass wherever indicated on the design, except where ends are raised at regular intervals by the shafts, to form the satin ground weave.

Stamping yellow plain, raises one half of the warp, and leaves the other half down wherever yellow is indicated on the design, thus forming a plain weave, with the red pick and the warp on the back of the cloth.

The lifting of the shafts to form a satin ground weave is generally accomplished by means of certain rows of hooks reserved at each end of the machine for that purpose, the order in which they are raised being indicated on the corresponding rows at the ends of both cards.

Brocatelle is the name given to another variety of silk damask containing several ends to

each mail. As originally woven, the warp was silk, and the filling silk, cotton, or wool. At the present time the term brocatelle is applied to a two-warp two-shuttle fabric used principally as furniture covering. Owing to the nature of the weave, the pattern, which may be formed by spun or organzine silk warp, on a tram silk filling ground, has a rich embossed appearance. The second warp, technically called the binder warp, may be either silk or fine cotton yarn, and is used for the purpose of stitching long floats of the tram silk pick on face and back, usually by means of four shafts forming a three-up and one-down straight twill; while the back pick is generally fine jute or linen the same color as the silk figure warp with which it forms an eight-shaft satin, also by means of shafts.

Designs for brocatelle should be treated in a bold conventional manner, with very little attempt at shading, which destroys the embossed effect of the pattern, and makes the fabric look cheap and common. The figure may be represented on squared paper by red, and the ground left white paper, and as the stitching on both picks is done by shafts, no indication of the same is required. The stitching of the silk pick by the binder warp is done by the head motion; but the satin weave formed by the silk figure warp and the backing pick, is indicated on certain rows at each end of the backing pick card, reserved for that purpose.

Brocade is the richest and most elaborate form of silk damask. It is structurally the same as the two- and three-shuttle damask referred to, but gold and silver filling are often used along with silk in order to enhance the beauty of the fabric.

In each case where reference has been made to the use of shafts they have been described as occupying a position at the back of the reed, and in front of the Jacquard harness, but during recent years a different method of using compound harness has come into use, the new shafts consisting of thin strips of wood hung lengthways, immediately below the Jacquard, and connected by means of cords to rows reserved at each end of the machine, for the purpose of raising them in satin order. The Jacquard harness cords are threaded through holes running from top to bottom of these shafts, so that when the Jacquard lifts, the cords are raised also without disturbing the shafts.

To illustrate: we will suppose that a 16-row fine index Jacquard is to be used for the production of double scale damask, with an eight-shaft satin ground. In this case the total number of ends in one repeat of the pattern would require to be divisible by eight, so that the satin might join at both sides of the repeat, and as the fabric desired is a double-scale weave, each row of 16 hooks would have to carry two shafts, equal to a total of 32 shafts, each controlling one thirty-second part of the warp, so that by raising four shafts in correct order for each pick an eight-shaft satin ground weave would be formed.

By using shafts in this manner there is less strain put upon the warp, as there is a separate harness cord and mail for each end, and no front shafts to trouble the weaver, who, as a result, will find it less difficult to tie in broken ends.

The cheaper grades of damask, embracing worsted hangings, table linen, cotton turkey red, and several other one-warp, one-shuttle weaves are designed and woven on the same general principle, one hook controlling a single harness cord and end; in each repeat of the pattern the square design paper also being in proportion to the exact number of ends and picks per inch, one color on the design representing all the various satins, twills, and shadings of the cloth; while the cards are stamped, and the cloth woven face up, or face down, according to the nature of the particular weave.

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