This invention relates to the folding and fixing of composite blanks, having reference to blanks that are laminated or composed of sheet materials, including fabric or similar limp facing and lining plies, which are mutually attached and combined by a cement. Such composite material is widely used for the production of certain articles such as pocketbooks, wallets and other cases and small articles of various sorts. The sheet material may consist of an ornamental or quality facing such as woven silk, rayon or the like, with a backing or strengthening lining of less expensive material such as buckram, gauze or the like, the combined materials giving a desirable weight and strength not afforded by the more expensive or facing material alone. The usual cement by which the plies are bonded or preattatched is one which is solid at normal temperatures but becomes liquid and flowable under suitable heat. It may be of a gelatinous or plastic character, although other kinds of cement are suitable for attaching together the two plies. The invention is applicable to any laminated fabric bonded by an adhesive that flows when hot.

A problem arises in the folding and fixing of blanks of such composite material in the manufacture of various articles therefrom. The actual folding of course can be done manually or mechanically, for example by means of apparatus or automatic machines which comprise a platens or bed to support each blank during folding, a templet for defining the fold, and a folder or infolder movable relatively to the templet to perform the folding, in an arrangement in which the templet can be extracted from the fold, and the folded material then squeezed under pressure between the platen and folder to press and crease the fold. It is desirable that the folder part, margin or infold of the blank be caused to adhere against the body of the blank, so that the folded blank will reliably retain its condition until subsequent stitching or other operations, and the cement which is present in the contiguous lining portions is potentially available to aid in the adherence of the infold to the body. However, if the folding and pressing are performed cold, then the cement will be inoperative as an adhesive between the fold and body. In automatic folding machines it is quite common to maintain highly heated parts which act upon the blank, but if that plan be followed with the composite blank then the facing becomes hot which rests upon the heated bed, and this, combined with the heat from the opposing folder renders the cement unduly liquid and fluent. It is found that the heat-softened cement tends to flow toward the source of heat, so that in the example mentioned the adhesive flows through the lining and into the facing of the body of the blank, thereby soiling or staining it to exterior view and spoiling the folded blank for use in a commercial product.

For these reasons the commercial types of folding machines and methods, although excellent for their mechanical performance, have never come into extensive practical use in the special field mentioned.

The general object of the present invention therefore is to provide a method and means for folding composite blanks, and fixing their folds, which will avoid the objections noted and will afford an accurate and reliable system of manufacture of folded composite blanks with high output and low cost of production. A particular object is to manipulate or operate the conventional or any supporting bed or platen and the relatively movable templet and folder as to bring about the folding and fixing of composite blanks to the desired shape without risking the soiling and disfigurement of the exteriorly visible facings of the blanks. A further object is to protect each folded blank from the distortion that may occur when it is heated excessively from both sides, and the adhesive penetrates to the platen or the folder, causing these parts to become sticky and tend to pull the folded product out of shape in removing it from position; or may get on to the templet which then, in its retraction, disturbs the blank. Other and further objects and advantages of the invention will be explained in the hereinafter following description of an illustrative embodiment thereof and will be understood by those conversant with the subject.

Considered as a method of infolding and fixing a blank of composite sheet material with the aid of platen, templet and folder, the present invention may be described as comprising the following steps. The bed or platen is kept at such a cool temperature as to maintain solid or non-flowable the cement by which the plies, layers or laminations are attached together, while on the other hand the folder or infolder is kept at such a warmer temperature as to render liquid or flowable the cement, preferably to a viscous or gummy consistency. Having established the predetermined respective temperatures for the bed and the folder, within suitable ranges, the operations upon each blank are commenced by placing the blank between the cool bed and the templet, with the facing ply of the blank toward the bed and its lining side defined by the templet to give the desired contour of folded blank. Having so defined the supported blank the next step is to move the folder relatively to the templet (the templet itself might be moved under the folder) in order to fold a portion of the blank, as to infold a margin thereof, over the edge of the templet, thus producing the desired fold; thereupon relatively extracting the templet from the fold, leaving the blank fold or infold between the bed and folder, having differential
temperatures as mentioned. Thereupon the blank fold is squeezed between the cooler bed and the warmer folder, or between the cooler fold and the warmer folder which is present in the two portions of the lining ply. The duration and pressure being insufficient to cause the fold edge and to cause its folded portion or margin to adhere to its body with the aid of the heat-softerened and liquefied cement which is present in the two portions of the lining ply, the duration and pressure however are insufficient to permit appreciable flow of the softened cement through or from the lining into the facing of the blank. By the steps thus described the facing exterior is protected by the cooler fold and the interior of the bed from being soiled or stained by the cement, as would frequently be the case were the bed not maintained at the differentially cooler temperature. After these actions the pressure is relaxed and the complete blank is removed and laid aside for subsequent stitching operation. The cement, not being heated for excessive fluidity, can not reach the operations, the platen, the folder or the temper, which otherwise would become sticky and impair the operations. The relative movements of bed, temper, and folder may be performed automatically under power operation, and following the removal of each completed blank a new unfolded blank may be presented to the mechanical elements and the steps repeated, for each subsequent blank, for quantity production of folded blanks in high quality and accuracy.

The method hereof is best expressed by reference to the apparatus elements or apparatus used in its performance, but in an abstract aspect may be considered irrespective thereof. Moreover, since the conventional apparatus and appliances are specially operated the invention may also be viewed as involving novelty of apparatus or combination. Various details of method and apparatus not specified in the preceding statements will be explained further in the following description of a practical embodiment of the invention.

In the accompanying drawing, Fig. 1 is a top plan view of an unfolded composite blank shown in its initial relations to a conventional apparatus including a supporting means or platen, a defining means or temper, and folding means or folders.

Fig. 2 is a vertical section taken on the line 2-2 of Fig. 1.

Fig. 3, on a scale twice that of Figs. 1 and 2, is a vertical section corresponding to the left side of Fig. 2, but with the material and parts in a later stage of operation.

Fig. 4 is a partial vertical sectional view on a scale eight times that of Figs. 1 and 2 showing the composite or laminated structure of the material or blank and its initial relation to the apparatus elements.

Fig. 5 is a vertical sectional view on the same scale as Fig. 4, but showing the later or squeezing stage of the operation.

Fig. 6, on the same scale as Fig. 1, shows the completely folded blank or product in top or face view.

Fig. 7, on a scale four times that of Fig. 6, is a vertical sectional view of part of the folded product taken on the line 7-7 of Fig. 6.

In the drawing, the blank B is shown in its original condition in Figs. 1 and 2 and in its final or folded and fixed condition in Figs. 6 and 7. The enlarged views, Figs. 4 and 5, show that the blank is composed of a facing or lower ply b and a lining ply b', the two being combined or preattached by cement b. Figs. 3, 5, 6 and 7 further show that the blank B comprises its main area or body portion b, and its inturnd or fold portion b', being usually a relatively narrow margin infolded upon the body of the blank, the extreme fold edge or crease b' being usually somewhat sharpened by the squeezing pressure.

The cement or adhesive between the facing and lining ply is or preattached into a laminated fabric, is of a kind which is not readily absorbed by the blank, but becomes liquid under heat. It may be of a gelatinous or plastic character, or for that matter any adhesive which answers the requirement, the heating being intended to convert it from a solid to a somewhat viscous or gummy consistency, so that it can flow within the material, but not so freely as to permeate through either portion of the facing of the folded blank, which would not merely disfigure the visible or exterior facing but would render sticky the mechanical parts and impair the operations upon the blank. An available cement is a glucose adhesive or an animal glue. The adhesive may remain solid at room or ordinary temperatures, say from 50° to 80° F. more or less, and may only soften say between 150° and 200° F. This of course is only one example.

The method is carried out by the apparatus or apparatus elements consisting of a platen or bed P for supporting the blank, the temper or defining side or temper T for determining the shape of the folded product, and the folder or folders F movable relatively to the templet for producing the blank folds and relatively to the platen for fold-squeezing purposes.

The platen P is shown in Figs. 2 to 5 as giving support to the blank. It may for example be in the form of the conventional bed of a folding machine, and may have a raised central portion or pad p, and thereupon outward extensions p'. The platen is to be kept at such a cool temperature as to maintain solid the cement, and prevent its flowing toward and into the blank facing which lies against it. Ordinary room temperature may constitute adequate coolness for the purpose; but since there is a tendency to accumulate heat during repeated operations, it may be desirable to form the platen with cooling means, conventionally shown as a system of fluid passages p' adapted to the circulation of cooling water, air or other fluid through the body of the platen.

The raw blank is placed between the cool platen P and the temper T, the latter being shown in Figs. 1 and 2 as being positioned upon the blank resting on the platen. The temper constitutes a defining means which is removable or contractible out of the folds of the blank. The illustrated blank being one folded on three sides only, the temper might be extracted by bodily sliding out of the blank; but preferably the temper is of the well known contractible type, and is shown as comprising a pair of defining plates or blades t each mounted at the lower end of a shank or upright carrier f, these in turn being movably mounted at the under side of a head or temple body fitted for descending and rising movements in a conventional manner. After the folding operation the temper is readily extractable by drawing toward each other diagonally the two defining blades thus leaving the blank folds between the platen and folders.

The folding means may comprise a plurality of folders, such as the two L-shape folders F,

F. These folders are movable relatively to the
templet, or inwardly and outwardly, so as to perform the folding of the blank margins and thereafter withdraw. At the front side there is shown a gap between the two folders, making allowance for their necessary approach during folding, and this gap may be bridged, in a conventional way, by a thin plate or piece of flat absorbable at the under side of one or both of the folders at this point. The folders may normally rest below the folding level, namely upon the platens extensions p', as shown in Fig. 2, and they may have first a rising movement to permit the inward movement, as shown in Fig. 3, and subsequently a downward depressing movement to squeeze the folders against the platen. Mechanism to afford these motions is not shown because the same may be conventional according to long known practice, but the motions may be described by means of the motion arrows appearing on Figs. 2 to 5. When the arrow z indicates the initial rise of the folder, the arrow y its inward or folding movement relatively to the templet, and the arrow x its downward pulling action for the squeezing, creasing and fixing of the folder; these three motions being reversed to restore the folders for operation on the next succeeding blank.

An essential feature of this invention is the maintaining of the folders at such a warm temperature as to render liquid the cement, at least sufficiently liquid or soft for interflow between the two contact portions of the blank lining so that they may be caused to adhere, thus fixing the blank infold portion to the body portion. Such infolder heating is itself well known for general folding purposes, and it may be performed by flowing steam through passages in the folders, but is conventionally herein shown as performed by electrical heating. Thus a series of resistance heaters H are shown, mounted on top of the infolders, approximately central thereof. These elements are indicated only diagrammatically, and the wiring is omitted since such details are well known to those conversant with electrical heating systems. Assuming that the laminated material contains a cement which liquefies at about 175° F. then the heaters H are to be operated to maintain an infolder temperature somewhat above, or approximately 212° F. In a typical case heaters consuming 600 watts may serve the practical purposes hereof. These figures are merely illustrative.

Regulation is important to keep the infolder temperature within a reasonable range, above the cement liquefying point to insure the described action, but not so hot that the cement will become unduly fluent and penetrate through the facing material on either the body or fold portion of the blank. A tacky or gummy consistency permits the interflow necessary to bind together the contacting portions of the lining, while avoiding penetration of the facing material. The regulation may be by observation by the aid of a thermometer and a manual switch, but it is preferably automatic by means of a thermostat switch for turning on and off the current energizing the heating coils. Fig. 1 indicates a thermostat or thermometer T assumed to extend into the body of each of the Infolders. The operation is that as soon as the infolder temperature reaches the top of the predeter-