May 30, 1961 R. F. DE MARCO 2,986,194

RAPID CYCLE STRETCH AND WIPE FORMING MACHINE

Filed Dec. 3, 1959 4 Sheets-Sheet 1

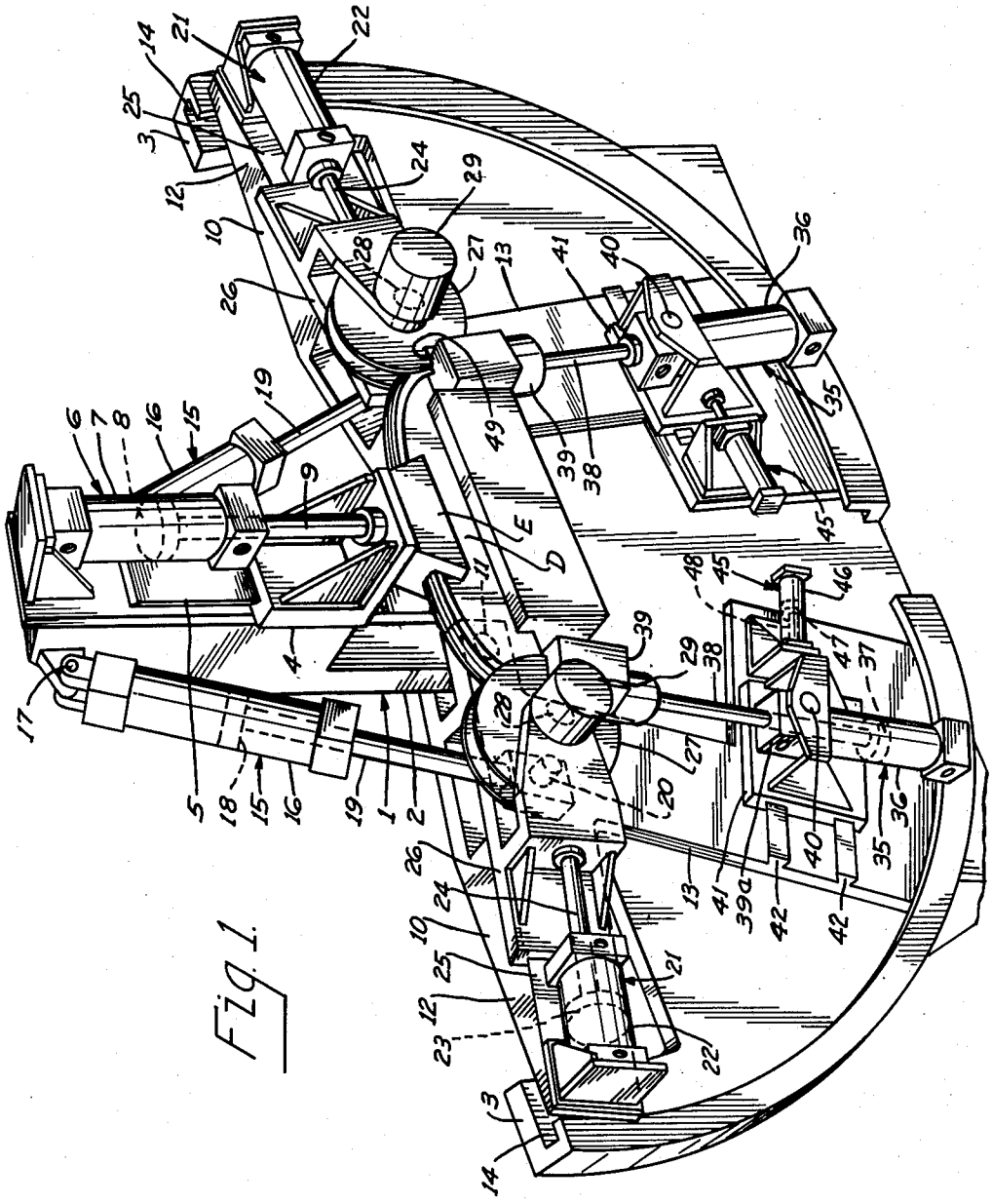

Fig. 1.

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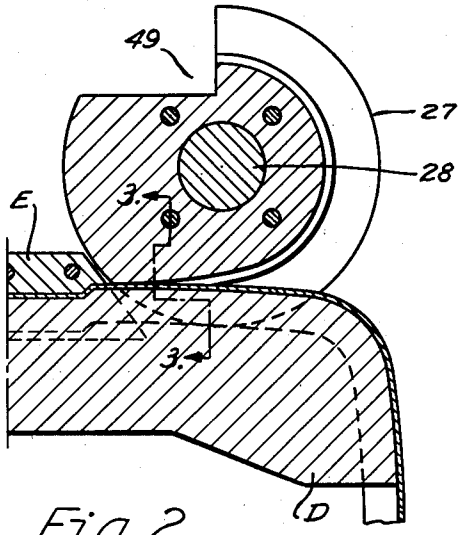


Fig. 2.

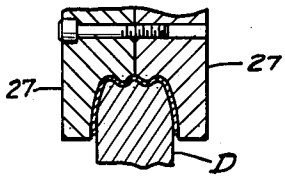


Fig. 3.

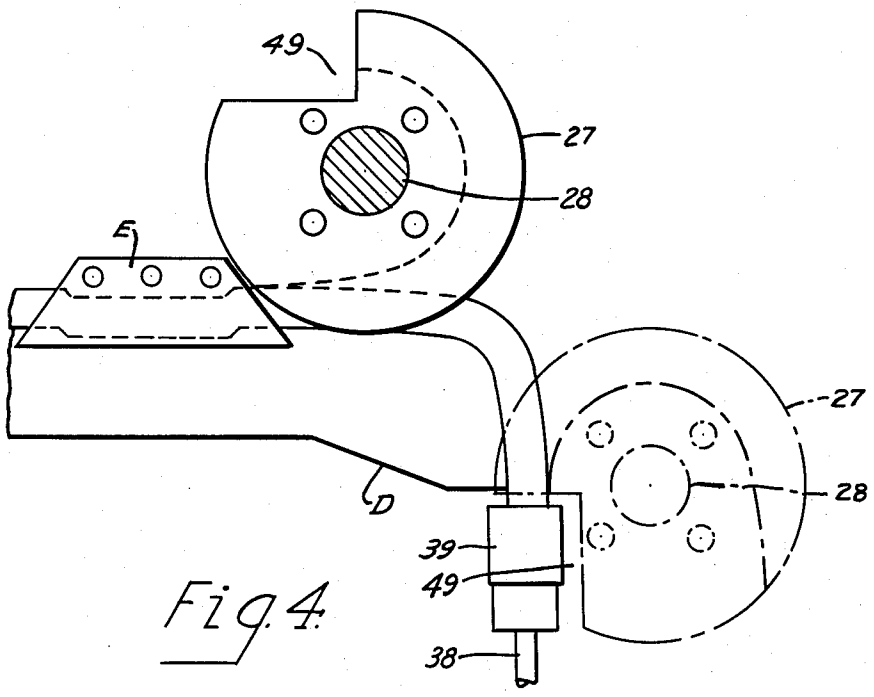


Fig. 4.

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Fig 5.

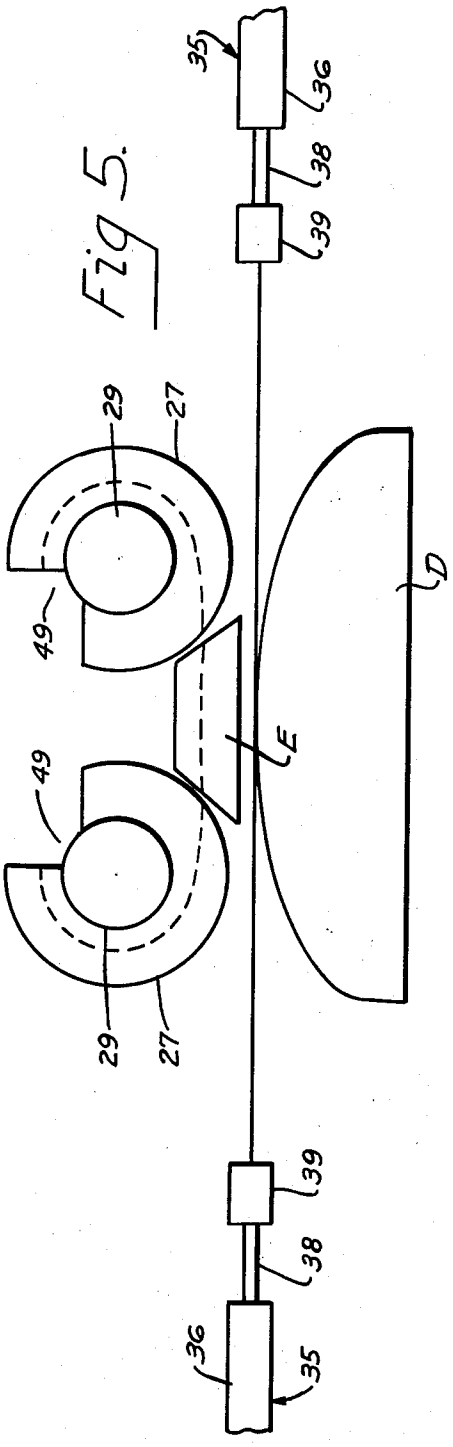
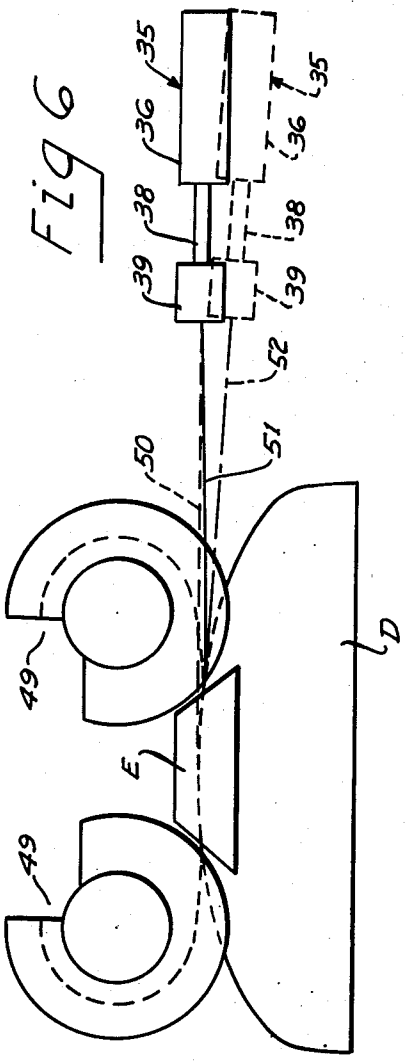



Fig 6

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RAPID CYCLE STRETCH AND WIPE FORMING MACHINE

Filed Dec. 3, 1959 4 Sheets-Sheet 4

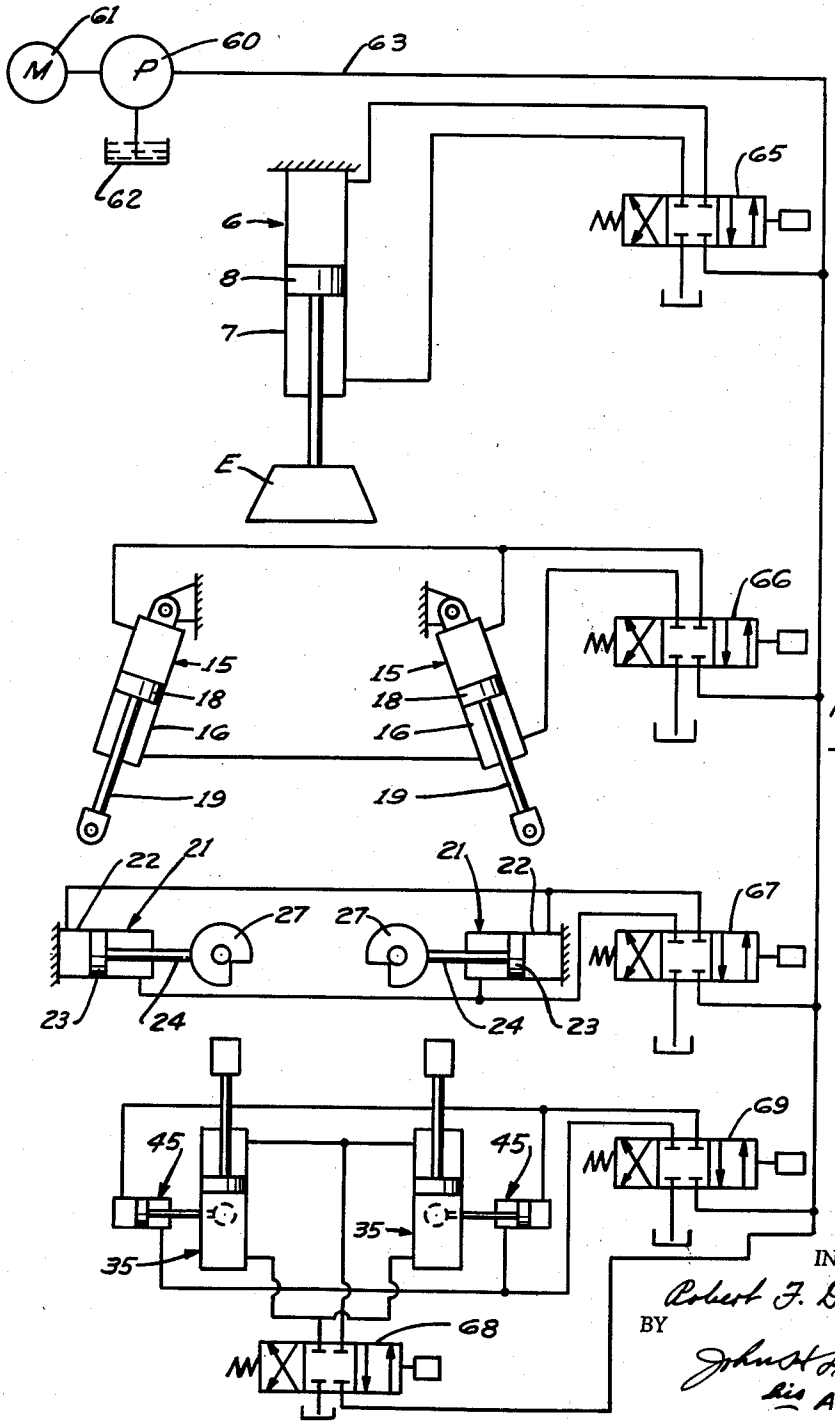


Fig. 7.

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United States Patent Office 2,986,194
Patented May 30, 1961



2,986,194

# RAPID CYCLE STRETCH AND WIPE FORMING MACHINE

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4 Claims. (Cl. 153—32)

This invention relates to a rapid cycle combined wipe and stretch forming machine, and particularly to a wipe and stretch forming machine in which the wipe forming assemblage and the stretch forming assemblage are carried on a common carrier about the side face of the die about which the metal is to be formed.

More particularly, the present invention is one wherein a stationary die is supported so that the metal can be stretched formed about its side face, a pair of piston and cylinder assemblages for stretch forming are carried by carriers which swing in opposite directions about the die so as to stretch form the metal onto the die face, and these same carriers each carries a wipe forming assemblage by virtue of which the stock is wipe formed onto the face concurrently with the stretch forming operation.

Another specific object is to provide a combined wipe and stretch forming machine with an embossing die by virtue of which the stock can be embossed at one location and held by the embossing die at that location while being stretch formed and wipe formed in opposite directions therefrom.

Various other objects and advantages will become apparent from the following description wherein reference is made to the drawings disclosing a bumper forming machine embodying the principles of the present invention, and wherein:

Fig. 1 is a perspective view of a machine embodying the principles of the present invention;

Fig. 2 is an enlarged fragmentary longitudinal sectional view of the machine illustrating the cooperation of the main forming die, the embossing die, and wipe shoe, with the stock;

Fig. 3 is a sectional view taken on a line 3—3 of Fig. 2;

Fig. 4 is a diagram showing the wipe forming shoes in position at the start of and at the end of the forming operation, respectively;

Fig. 5 is a diagrammatic illustration of the forming parts of the machine in a starting position preparatory to being applied to the stock;

Fig. 6 is a diagrammatic illustration showing a condition of the parts of the machine to be overcome by one feature of the invention, and illustrating certain problems in the position of the stretch forming assemblages; and

Fig. 7 is a flow diagram illustrating a simple hydraulic operating and control system which may be used in connection with the machine.

Referring to the drawings, the machine comprises a frame, indicated generally at 1, having an upright portion 2 and a lateral guide portion 3.

Mounted on the frame in fixed position is a side face die D having its forming face disposed upwardly and generally horizontally.

Mounted on the upright portion 2 is a sliding die support 4 on the lower end of which is carried an embossing die E arranged for cooperation with the side face of the die D near the mid-portion thereof. The embossing die E is arranged to be moved upwardly away from the die D and downwardly into engaging position therewith.



For this purpose, the slide 4 is carried on a suitable upright guide 5 on the frame portion 2. A suitable piston and cylinder assemblage 6 including a cylinder 7 and a piston 8 having a rod 9 are mounted on the upright frame portion 2. The cylinder 7 is fixedly secured to the frame and the piston rod 9 is connected to the carrier 4 for movement therewith. Thus, upon operation of the piston and cylinder assemblage 6, the embossing die E may be moved to raised and lowered positions, respectively. As mentioned in the objects, it is desired to effect an embossing operation on the workpiece while stretch forming and wipe forming the workpiece. For this purpose, a pair of arms 10 are mounted on the frame. Each of the arms 10 is arranged to swing about a horizontal axis. In the form illustrated, the arms are shown as supported on trunnions or pivots 11 for swinging about separate axes.

Each arm 10 is comprised of a wipe forming assembly supporting portion 12 and a stretch forming assembly supporting portion 13, these portions being in fixed position to each other and rotatable as a unit about the axis of their pivot 11 and providing a carrier pivotally connected to the frame for swinging about a predetermined axis. The radially outward or peripheral margins of the portions 12 and 13 provide guide means which are received in suitable guideways 14 in the guide portion 3 of the frame and coaxial with the pivots 11, respectively, for preventing the arms from warping or springing out of their planes normal to the axes of the pivots 11.

In order to swing the arms about the axes of their pivots 11, they are provided with a piston and cylinder assemblage 15, respectively, each of which includes a cylinder 16 pivotally connected at 17 to the frame portion 2. Reciprocable in each cylinder 16 is a piston 18 having a rod 19 which is pivotally connected, as indicated at 20, to its corresponding one of the arms 10. Thus, by manipulation of the assemblages 15, the arms 10 can be swung from a starting position, in which the wipe forming shoes are adjacent the ends of the embossing die, outwardly and downwardly to the position illustrated in Fig. 1.

In the form illustrated, each arm and its assemblages are essentially the same in form and function, and one arm only will be referred to in detail.

The wipe forming assemblage of the arm 10 comprises a piston and cylinder assemblage 21 including a cylinder 22 secured in fixed position on the arm portion 12 and a piston 23 reciprocable in the cylinder and having a rod 24. A slideway 25 is mounted on the arm portion 12 and extends parallel to the axis of the piston and cylinder assemblage 21. A slide 26 is mounted on the slide 25 for movement toward and away from the working face of the die D and is connected to the piston rod 24 for actuation by the piston and cylinder assemblage 21. In the form illustrated, the assemblage carries a wipe shoe comprising a roller 27 configured so as to conform properly to the side face of the die D. Since it is desired that the roller initially engage the stock in a predetermined rotated position, each roller is mounted on a shaft 28 which, in turn, is connected to a suitable coil spring return 29 so arranged that, as the roller rolls from starting position to final position, the spring is wound up, and when the roller is released, it is returned to its starting rotated position about its shaft and stopped in that position. The wipe shoe roller 27 is arranged to engage the stock adjacent the opposite ends of the embossing die E when starting the cycle. However, it is necessary in order to properly feed the stock into the stretch forming mechanism, that the stretch forming piston and cylinder assemblages be arranged so as to engage the opposite ends of the stock and hold it tangential-

ly to the midportion of the side face of the die D preparatory to the engagement of the stock by the embossing die or the wipe forming shoes **27**. At the same time, after the stock is initially stretched by the stretch forming assemblages, it must be partially laid on the die face so that there is no tendency toward reverse bending of the stock away from the die face by the stretch forming assemblages after the application of the embossing die and the wipe forming shoes **27**, all as is explained more fully hereinafter in connection with the operation of the machine.

Each stretch forming assemblage comprises a piston and cylinder assemblage **35** including a cylinder **36** with a piston **37** reciprocable therein and having a piston rod **38**. A stretch forming head **39** is carried on the outer end of the rod **38** and is adapted to clamp at one end of the length of stock for exerting tension thereon.

For the purposes described in U.S. Patent No. 2,514,830, issued July 11, 1950, to Cyril J. Bath, it is desirable that the stretch forming assemblage be arranged for pivoting about an axis on the arm portion **13** so that it can position itself with its cylinder axis in proper tangential relation to the instantaneous line of contact of the stock and the side face of the die D. For this purpose, the cylinder **36** is supported in a suitable mounting bracket **39***a* which is connected by a pivot **40** to a suitable slide **41**, the axis of the pivot **40** being at right angles to the axis of the cylinder and normal to the plane of the arm portion **13**.

The slide **41** is mounted on guideways **42** so that it can slide in a direction parallel to a plane normal to the axis of the pivot **40** and the pivot **11**. Mounted in fixed position on the arm portion **13** is a reversible piston and cylinder assemblage **45** including a cylinder **46** and a piston **47** reciprocable therein and having a rod **48** connected to the slide **41**. Thus, upon operation of the piston and cylinder assemblage **45**, the entire slide **41**, and thereby the assemblage **35**, can be shifted parallel to the face of the arm **13**. The direction of the guideway **42** is such that the movement of the slide **41** is substantially in the direction of travel of the arm portion **13** as the arm **10** is swung about its pivot **11**. By shifting the slide **41**, the pivot of the piston and cylinder assemblage **35** can be shifted forwardly and rearwardly in the direction of travel of the arm portion **13** during the forming operation.

Referring first to the Figs. 2 through 6, the piece to be formed is shown as a bumper for an automobile and of which the center portion must be formed by the embossing die E and the side face die D. In order that the wipe shoe **27** may be brought as closely as possible adjacent to the stretch forming head **39** at the end of the forming stroke, the shoe **27** is provided with a notch, indicated at **49**, which allows the shoe **27** to approach as near as can be its associated head **39**. For this purpose, the self-restoring means **29** described are provided to rotate the wipe shoes **27** to the proper starting position so that they can be applied to the stock initially very closely adjacent to the ends of the embossing die E. In general, the side face of the die D has its highest point at its mid-portion, this being dictated in general by the shape of the part to be made. However, in starting stretch forming of a piece of stock thereon, it is necessary that the piece of stock be tangential to, and spaced above, the highest point of the die D initially for the purpose of feeding and obtaining the proper stress on the stock. As illustrated in Fig. 6, a normal position of the stretch assemblies for this purpose would be with the stock in the position indicated by the dotted line **50**. This requires that the axis of the two stretch forming piston and cylinder assemblages **35** be parallel and lie in a common plane tangent to the crest of the side face of the die D. If, in this position the embossing die and the wipe shoes **27**, were applied, then the stock would be deflected downwardly at its mid-portion by the die E and shoes **27** and would assume the position illustrated by the solid line **51**. In such an instance, there would be a component of tensioning force directed back upwardly against the embossing die E and the wipe forming shoes **27**, which would be very undesirable. On the contrary, it is desirable that, when the embossing die E and the wipe forming shoes **27** are moved into their initial stock engaging position, the stock be tensioned endwise and positioned as indicated by the dot and dash line **52**, in which case it would be partially curved around the crest of the side face of the die D and be tangential to the side face of the die D substantially at the outermost limits of engagement of the shoes **27** with the stock in the starting position. However, since each wipe forming assemblage and stretch forming assemblage at one end of the die is carried on the same arm, necessarily the proper position for starting could not be achieved as the arms **10** are swung to lower the stretch forming piston and cylinder assemblage **35** to position to apply a tensioning force and locate the stock, as indicated by the dot and dash line **52**. Were the stretch forming assemblages **35** so positioned, then the wipe forming shoes **27** would be spaced outwardly beyond the ends of the embossing die E when first applied so that the stock would not be engaged immediately adjacent the embossing die.

It might at first be assumed that the wipe forming assemblages **21** could be moved a greater angle apart from the stretch forming assemblages **35**. However, this is precluded because of the mechanism for operating the embossing die E. Furthermore, if an attempt were made to correct the matter in this manner, then by the time that the wipe forming shoe **27** had reached the end of the die D, the stretch forming assemblage would be pulling the stock around the sharp corner at the end of the forming face of the die D. It is for this reason that the stretch forming assemblage is mounted on the slide **41** so that its pivotal axis **40** can be shifted to different positions for a short distance in the direction of travel.

Referring again to Fig. 6, it is to be noted that the normal position of the stretch forming assemblage **35**, if the stock were to be stretched tangent to the highest point of the face of the die D preparatory to applying the embossing die E and the wipe forming shoes **27**, would be above the level indicated by the dot and dash line **35***a* required for positioning of the assemblage **35** in order to have the stock tangent to the side face of the die at the instantaneous point of contact after the embossing die and the wipe shoes are applied. Accordingly, therefore, with the wipe shoes **27** and the embossing die E in raised position, the stock is clamped at opposite ends by the heads **39** of the assemblages **35** and in that position is in a position in which these assemblies have their axes aligned with each other and lie in a common plane, as illustrated in Fig. 5. Thereupon, tension is applied and before the die E and the wipe shoes **27** are applied to the stock, the piston and cylinder assemblages **45** are operated to move the stretch forming assemblages **35** downwardly in opposite directions to the dotted line position shown at **35***a* in Fig. 6. In this position, the stock is partly stretched about the peak of the side faced die D so that the instantaneous line of contact at each side of the center of that face of the side face die is substantially at the point at which it will be engaged by the applied wipe forming shoes **27**. Thus, the embossing die E and the wipe forming shoes **27** are initially applied to the stock after the stock has been laid onto the side face of the die D sufficiently far from the longitudinal mid-portion of the face so that it is directly pressed against the die face by the die E and shoes **27**, and there is no tensioning component tending to pull the stock away from the side face of the die.

With the shoes **27** in this position and the embossing die E applied, the arms **10** are swung in opposite directions about the axes of the pivots **11** so as to concurrently stretch form the stock about the die and wipe it onto the die D.

However, during this operation, after the stretch forming assemblages **35** have moved downwardly so that the stock at its ends is tangent to the end of the side face, then the piston and cylinder assemblages **45** are operated to shift the pivots **40** of the stretch forming assemblages **35** back toward their starting position so that the angularity, in the direction of swinging, of the wipe forming assemblages **21** and the stretch forming assemblages **35** about the axis of the pivots **11**, is restored to that which it was originally. By this means, the angularity of the wipe forming shoe **27** of each arm and the stretch forming head **39** thereof about the axis of the pivots **11**, may be varied.

Referring to Fig. 7, any suitable means for controlling the operation of the various assemblages in the sequence desired may be provided. For purposes of illustration, applicant has shown merely remote control solenoid operated valves leaving the control of the operation to the manipulation of the valves by the operator. For the purposes of operating the various assemblages, a suitable pump **60** driven by a motor **61** and connected at one side to a sump **62** and at the other side to a pressure line **63**, is provided. For operating the embossing assemblage **6**, a suitable solenoid operated control valve **65** is connected to the opposite ends of the cylinder **7**, as illustrated. This valve may be one of the conventional solenoids operated remote control valves which, in the position illustrated, locks the piston and cylinder assemblage **6** hydraulically and in another position causes the assemblage to move to extended position to apply the embossing die E, and in a third position, causes the assemblage **6** to retract the die E. Correspondingly, the assemblages **15** are connected in parallel to a control valve **66** which is similar in all respects to the valve **65**. The wipe forming assemblages **21** likewise are connected in parallel to a control valve **67**. The stretch forming assemblages **35** are connected to the pump through corresponding control valve **68**, and the stretch forming adjustment assemblages **45** are connected through a control valve **69** to the pump. Thus, by operating the valves **65** through **68** in the sequence desired, the effect desired can be obtained.

Generally, the operation is such that the arms **10** are swung upwardly to starting position in which the piston and cylinder assemblages **35** are such that they can stretch the stock endwise while holding it tangent to the midportion of the die face D. Having thus stretched the stock initially, the assemblages **45** are operated to shift the pivotal axes **40** of the assemblages **35** downwardly, thus to the dotted position illustrated at **35***a* in Fig. 6. While they are held in this position, the embossing die E is applied and immediately thereafter the wipe shoes **27**. With the die E and wipe shoes **27** in initial contact position, the assemblages **15** are operated to swing the arms **10** downwardly, thus effecting the combined wipe and stretch forming operation while the central portion of the stock is held by the embossing die. When the stock reaches the end of the side face and is tangent thereto, the piston and cylinder assemblages **45** are operated to restore the pivotal axes **40** to their starting position. If desired, this operation can be delayed until after the piece has been removed.

Having thus described my invention, I claim:

1. In a combined wipe and stretch forming machine, a frame, a side face die mounted thereon, a carrier pivotally connected to the frame for swinging about a predetermined axis on a forming stroke, a wipe forming assemblage mounted on the carrier including a wipe shoe yieldably urged thereby toward the side face of the die, a stretch forming assemblage mounted on the carrier and including a stretch forming head yieldably urged thereby endwise of the side face, said shoe and head being positioned so that the head is ahead of the shoe in the direction of travel as the carrier moves on its forming stroke, power means for the assemblages, respectively, means supporting the stretch forming assemblage on the carrier for movement along a path such that the distance at which the head precedes the shoe in the direction of travel on the forming stroke is varied, and power means for moving the stretch forming assemblage along said path.

2. A machine according to claim 1 including a pressure forming die cooperable with the face of the side face die in spaced relation to the ends of the side face die, and positioned with one end substantially engaging the adjacent end of the wipe shoe in the starting position of the carrier and forming position of the pressure forming die.

3. A machine according to claim 1 including a carrier having a guide rotatable with the carrier about said predetermined axis, a rigid cooperable guide on the frame accommodating the guide on the carrier and constraining the carrier to move in a path parallel to a plane normal to said predetermined axis.

4. In a combined wipe and stretch forming machine, a frame, a side face die mounted thereon, a carrier pivotally connected to the frame for swinging about a predetermined axis on a forming stroke, a wipe forming assemblage mounted on the carrier, a wipe shoe carried and yieldably urged thereby toward the side face of the die, a stretch forming assemblage, a pivot means securing the stretch forming assemblage to the carrier for swinging about an axis parallel to, and offset from, the predetermined axis, a stretch head connected to the stretch forming assemblage and yieldably urged thereby endwise of the stock and die face, said shoe and head being positioned so that the head is ahead of the shoe in the direction of travel as the carrier is swung on its forming stroke, power means for the assemblages, respectively, additional power means to swing the carrier on its forming stroke, means connecting the pivot means to the carrier for movement, relative to the carrier, transversely of its pivotal axis in opposite directions, generally endwise of the path of travel of the carrier, to different positions relative to the carrier, to change the distance by which the stretch head precedes the wipe shoe, and auxiliary power means to move the pivot means to said positions, selectively.

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