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Jope et al.

[11] **3,726,148**

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[54] SHEET ADVANCE APPARATUS

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[22] Filed: **Feb. 22, 1971**

[21] Appl. No.: **117,254**

Related U.S. Application Data

[62] Division of Ser. No. 860,874, Sept. 25, 1969, Pat. No. 3,613,979.

[52] **U.S. Cl.** **74/121**, 74/46, 74/79, 74/84

[51] **Int. Cl.**.....**F16h 29/08**

[58] **Field of Search**.....74/79, 46, 48, 84, 74/121, 119

[56] **References Cited**

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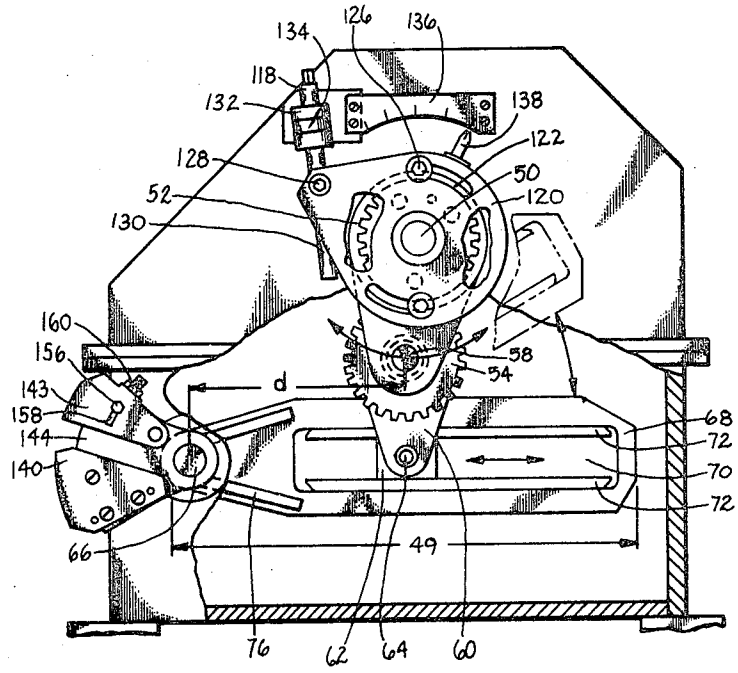
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[57] **ABSTRACT**

Apparatus for intermittently advancing successive equivalent length portions of a generally continuous sheet through an upstream article forming station. A gear assembly intermediate drive means and a sheet advance roll includes oscillating arm means which, in combination with a brake on the roll, controls its acceleration and deceleration to provide smooth sheet movement. The extent of sheet displacement may be quickly changed by a lever having a portion mounted exterior to the housing of the gear assembly which, when rotated, changes the center distance between a rotary crank in the input drive train and a pivot shaft of the oscillating arm means which receives power from the input drive train.

4 Claims, 8 Drawing Figures



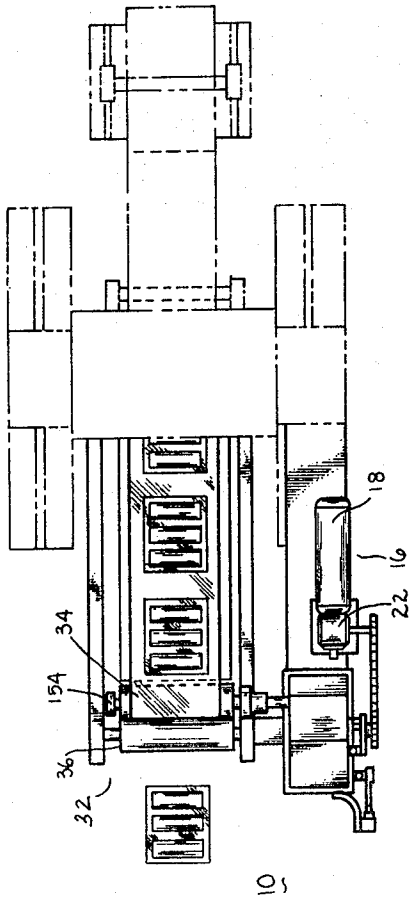


FIG. 1

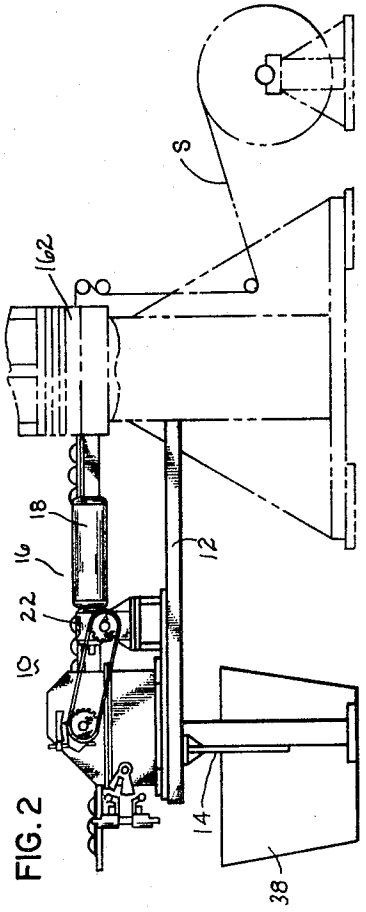


FIG. 2

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FIG. 3

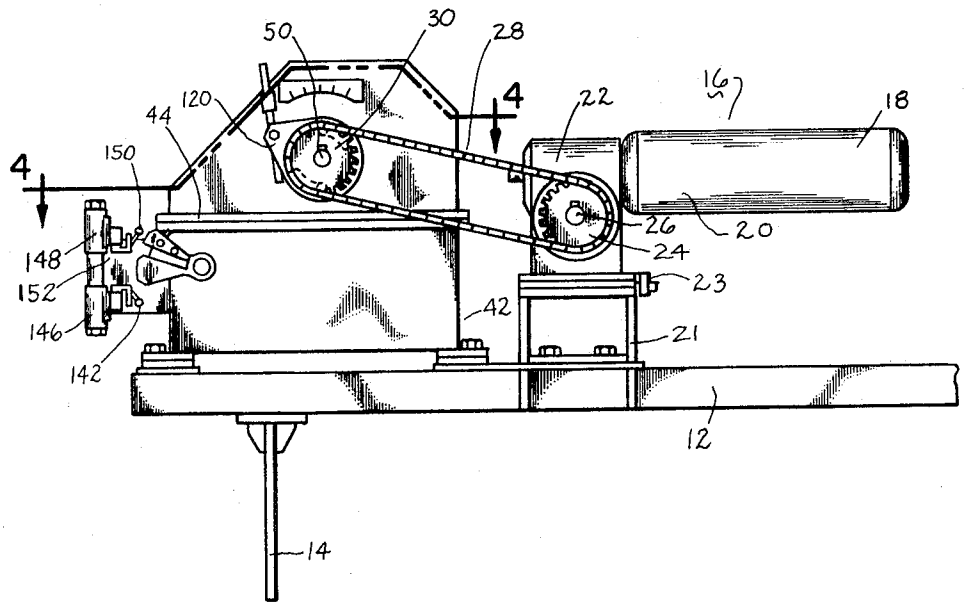
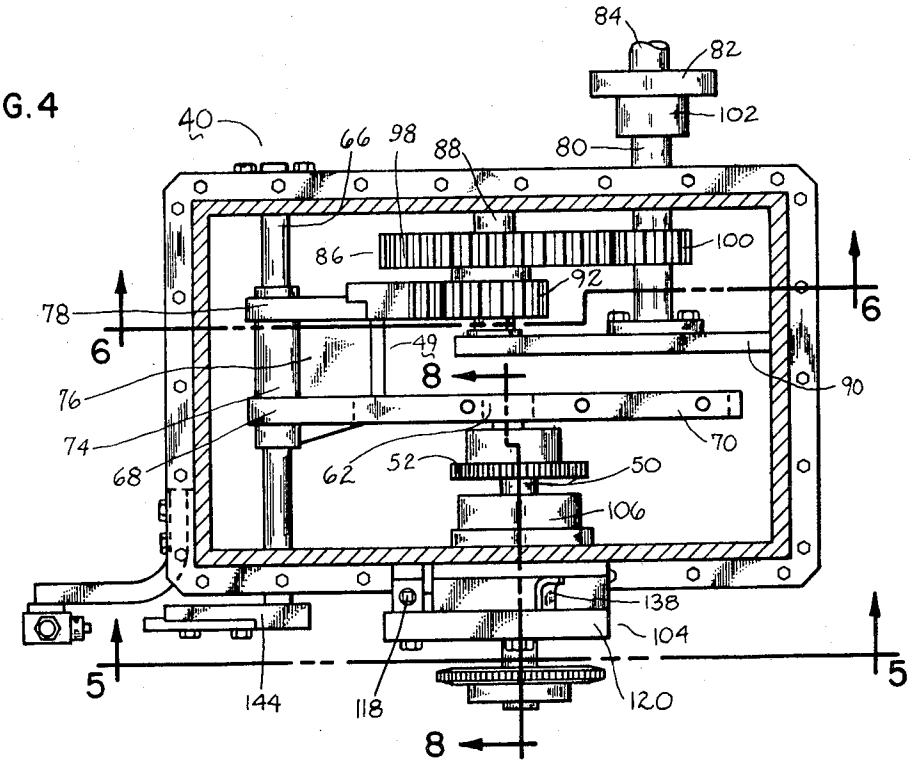


FIG. 4



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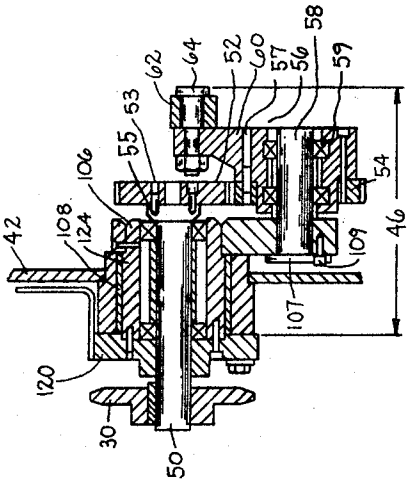


FIG. 8

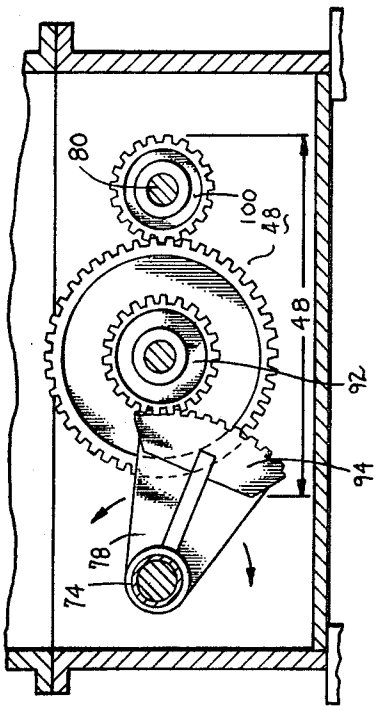


FIG. 6

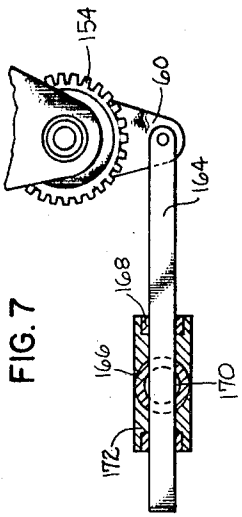


FIG. 7

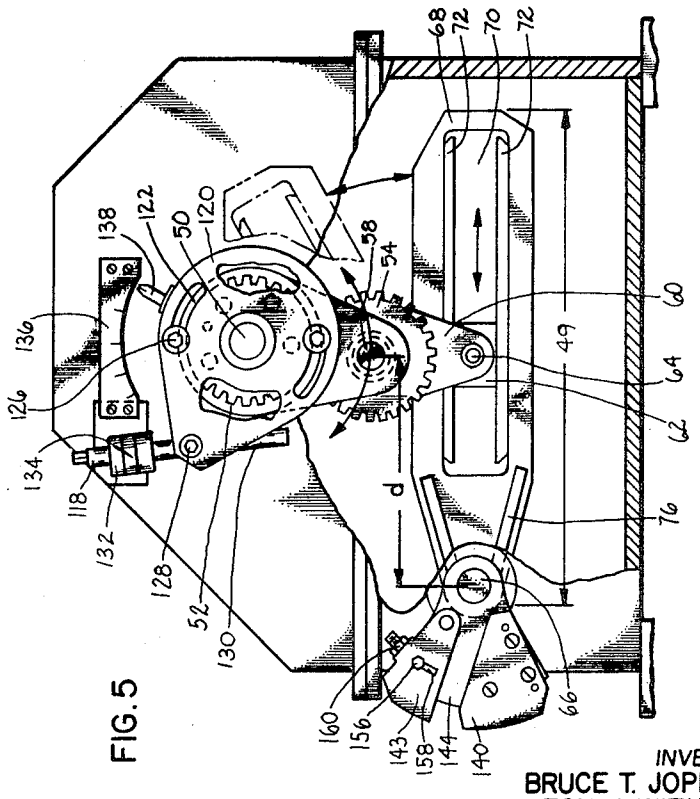


FIG. 5

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SHEET ADVANCE APPARATUS

This is a division of copending application Ser. No. 860,874, filed Sept. 25, 1969, now U.S. Pat. No. 3,613,979.

BACKGROUND OF THE INVENTION

This invention relates in general to improvements in equipment for forming articles from sheet, and in particular to improvements in apparatus for advancing the sheet through an article forming press.

Several different types of forming are known for simultaneously shaping large numbers of articles in a single cycle from portions of a generally continuous plastic sheet. One technique is by pneumatic pressure differential forming of container depressions in a large heated area of the sheet against the surfaces of mold cavities using peripheral sealing blades to hold the pressure in each mold during forming, followed by a creasing of the web by the blades around the formed articles at the seal while still in the press. This creasing is almost but not entirely through the web, in order that the articles may be transferred out of the forming station and thereafter easily peeled from the web along the creases by merely directing the web in a direction different from that of the containers. The scrap sheet with the containers removed therefrom passes through the nip of a pair of opposing rolls whereupon it may be cut up or stored as desired. U.S. Pat. No. Re 26,413 illustrates a machine operating on these principles. This type of forming is referred to as a type of trim in place thermoforming as opposed to post trim thermoforming wherein a separate trimming press is required downstream of the forming operation to separate the containers from the sheet, or the cut in place technique wherein the articles are entirely severed from the sheet while in the forming press and then must be individually removed therefrom. From the standpoint of speed and economy, trim in place thermoforming of the first mentioned variety is highly desirable since the portion of the sheet or web between the mold cavities is used to transport the containers out of the forming press while the articles are still attached to the web, thus facilitating subsequent removal by simple peeling.

The means used to advance the generally continuous sheet through the forming press of a trim in place installation is generally positioned downstream of the station where the articles are disengaged from the sheet, and operates by pulling on the scrap sheet from which the articles have been removed. Since the scrap sheet is integrally connected to the upstream sheet through the portions intermediate the sections where the articles are formed, this pulling in turn moves generally continuous upstream sheet portions into and out of the forming press. Needless to say, the extent of sheet advance during a cycle of the equipment must be rather accurately controlled, since if it varies on the low side, articles formed in the previous cycle may still have portions left within the forming press which may be crushed when the press closes for the next cycle, whereas if it varies on the high side, sheet utilization is decreased since the portion of the sheet between adjacent sets of articles from successive cycles is greater than need be and the amount of scrap is high. The sheet must also be advanced quickly to minimize cycle time, yet movement must be smooth in the sense that it is without sudden stops and starts, since if the sheet is jerked it may cause stretching of heated portions and premature stripping of the easily removable articles from the sheet, whereas a sudden stop will cause sheet buckling. Also, since the product configuration being formed during a given run is usually only one of many possible varieties, it is necessary to frequently change the amount of sheet advance for a cycle by changing or altering the parts of the sheet advance means to accommodate a different size or shape of product to be made during the next run Obviously, it is desirable to be able to make these changes quickly and with a minimum of effort to minimize changeover costs.

Though the means used to advance the sheet in the past has generally performed satisfactorily, it has been different at one time or another in one or more of the above mentioned areas. Thus mechanical stops mounted on a drive chain were used to delimit the stroke of a pneumatic piston to define the limits and change the extent of sheet advance. After extended periods, these would become loose and sheet travel would vary. The speed of the piston stroke which determines the rate of sheet advance could not be controlled throughout the extent of its travel and this resulted in jerky sheet movement.

Now there has been developed a unique apparatus which provides rapid yet smooth sheet advancement high repeatability of sheet travel during successive cycles and easily variable sheet displacement.

Accordingly, it is a principle object of this invention to provide an improved sheet advance apparatus component for use in an equipment system for forming articles from sheet material.

Another object of this invention is to provide an improved apparatus for intermittently advancing successive equivalent length portions of a generally continuous thermoplastic sheet through an upstream article forming station wherein sheet movement is rapid yet smooth in the sense that it is free of abrupt starts and stops.

A further object of this invention is to provide apparatus of the aforementioned variety which is versatile in the sense that it may be readily adjusted to change the extent of sheet travel in a minimum amount of time.

An additional object of this invention is to provide apparatus of the aforementioned variety wherein the rate of change of sheet velocity during advancement is controlled over the full extent of the sheet travel.

A further object of this invention is to provide apparatus of the aforementioned variety wherein the accuracy of sheet displacement is high and reproducible over extended periods of use.

Other objects of this invention will in part be obvious and will in part appear hereinafter.

SUMMARY OF THE INVENTION

These and other objects are accomplished by providing apparatus for intermittently advancing successive equivalent length portions of a sheet through an upstream article forming press comprising, in combination, cylindrical sheet advance means including a sheet drive roll with which a scrap portion of the sheet comes into peripheral contact during its advancing movement, drive means for intermittently rotating the sheet drive roll, a gear assembly intermediate the sheet drive roll and the drive means for controlling the amount of rota-

tion and the speed of rotation of the sheet drive roll throughout the full extent of the sheet advance movement, a housing for the gear assembly and means associated with the housing and the gear assembly to permit externally changing the position of components of the gear assembly within the housing to facilitate rapid adjustment of the amount of rotation of the sheet drive roll.

The gear assembly includes oscillating arm means intermediate an input and an output gear train. The oscillating arm means includes an inside-outside arm which is driven by a constant r.p.m. crank in the input gear train. A slider block pivotally connects the crank to the arm such that the rotary motion of the crank is converted to oscillatory motion of the arm. The arm is fixedly mounted on a pivot shaft which is connected into the output gear train to thereby transmit the oscillatory motion to the sheet drive roll which is coupled to the output gear train.

Means are provided to arrest the rotary motion of the sheet drive roll during the latter part of the sheet advance cycle, which means includes a magnetic brake on the sheet drive roll which is energized by a switch activated by the oscillating arm at about the mid point of the first half of its swing, so as to drive the sheet advance roll through the deceleration latter portion of the swing of the arm.

The means for externally changing the position of components of the gear assembly within the housing includes an adjusting flange pivotable about the input shaft of the gear assembly. An input force may be applied externally of the housing to change the position of a stub shaft about which the crank rotates which in turn changes the center distance between the crank and the pivot shaft of the oscillating arm means which transmits the oscillatory motion to the output gear train.

BRIEF DESCRIPTION OF THE DRAWINGS

In describing the overall invention, reference will be made to the accompanying drawings in which:

FIG. 1 is a plan view of an equipment system for forming articles from plastic sheet illustrating the sheet advance assembly of the invention in dark lines and the remaining portions of the system in phantom;

FIG. 2 is a partial, side elevational view of the equipment system of FIG. 1;

FIG. 3 is a side elevational view of the sheet advance assembly of FIG. 1;

FIG. 4 is a sectional view taken along 4—4 of FIG. 3;

FIG. 5 is a schematic, elevational view taken along 5—5 of FIG. 4;

FIG. 6 is a partial, sectional view taken along 6—6 of FIG. 4;

FIG. 7 is a schematic view, partly in section, of an optional arrangement of parts of a portion of the sheet advance assembly; and

FIG. 8 is a sectional view taken along 8—8 of FIG. 4 with rotating parts shown in a slightly different position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein identical numerals refer to identical parts, there is shown in FIGS. 1 and 2, a trim in place thermoforming assembly for simultaneously forming a plurality of articles from thermoplastic sheet material. This assembly includes apparatus generally indicated as **10** for intermittently advancing successive equivalent length portions of a thermoplastic sheet S through a known, conventional upstream forming station shown in phantom in FIGS. **1** and **2**. Further details of the operation and construction of the known components of the thermoforming assembly are set forth in U.S. Pat. No. Re 26,413, issue June 15, 1968, the content of which is herein incorporated by reference.

Apparatus **10** may be supported on a frame **12** which is fastened to the main frame of the forming press, and may in turn be supported on any stationary surface by one or more stanchions **14**.

Apparatus **10** (FIG. **3**) includes drive means, generally indicated as **16**, which comprises variable speed D.C. motor **18** having a conventional electromagnetic clutch-brake assembly generally indicated as **20** included within its housing. Gear reducer **22** is connected to the output shaft of clutch-brake assembly **20** and in turn has drive sprocket **24** keyed on its output shaft **26**. Endless chain **28** is supported about the periphery of drive sprocket **24** and driven sprocket **30**. Pedestal **21** supports drive motor **18**, electro-magnetic clutch-brake **20** and gear reducer **22** on frame **12**. An adjustable slide **23** may be provided for setting the tension of chain **28**.

Cylindrical sheet advance means **32** (FIG. **1**) are provided downstream of the area at which the containers are peeled out of the sheet. This cylindrical sheet advance means includes sheet drive roll **34** and immediately adjacent driven roll **36** which together form a nip through which the scrap sheet passes, for example into recovery container **38** below the assembly. As is apparent from FIG. **1**, the scrap portion of the sheet after removal of the containers comes into peripheral contact with roll **34** during the advancement of the sheet as a result of the pressure developed at the nip.

A gear assembly, **40** (FIG. **4**) is provided intermediate sheet advance drive roll **34** and drive means **16** for controlling the amount of rotation and the speed of rotation of drive roll **34** throughout the full extent of the sheet advance movement. A housing or casing **42** split along its mid point by means of flanges **44** is provided for gear assembly **40**. Gear assembly **40** comprises an input gear train generally indicated as **46** (FIG. **8**), an output gear train **48** (FIG. **6**) and oscillating arm means **49** (FIG. **5**) interconnecting input gear train **46** with output gear train **48**.

Input gear train **46** comprises unidirectional input rotary drive shaft **50** on which driven sprocket **30** of drive means **16** is conventionally keyed to transmit power from drive means **16** to input gear train **46**. Driving gear **52** (FIG. **8**) of input gear train **46** is mounted on drive shaft **50** on the opposite end from that on which sprocket **30** is located. Gear **52** meshes with driven gear **54**, which itself is pinned at **57** to crank **56**. Crank **56** comprises slider block arm **60** and slider block **62** which is pivotally mounted on slider block arm **60** by means of pivot pin **64**. Crank **56** is rotatable about stub or crank shaft **58** by means of bearings **39**.

Oscillating arm means **49** (FIG. **4**) comprises pivot shaft **66** rotatably mounted at either end by means of

conventional bearings in the wall of the lower portion of housing 42. Means 49 further comprises an inside-outside arm 68 having a track 70 formed therein within which slider block 62 reciprocates as generally indicated in FIG. 5. Track 70 has two horizontal steel guides 72, one on either side of slider block 62 to keep block 62 confined within track 70. Means 49 further includes hub 74 on which arm 68 is mounted. Hub 74 is pinned to pivot shaft 66 and comprises stiffening web 76 intermediate plate 78 and arm 68.

Output gear train 48 (FIGS. 4 and 6) comprises output shaft 80 coupled at 82 to shaft 84 of sheet advance drive roll 34. Intermediate step up gearing 86 on intermediate shaft 88 is rotatably mounted in conventional bearings at one end in a wall of housing 42 and at its other end in partition wall 90 within housing 42. Wall 90 also acts as a support for bearing mounted output shaft 80. Intermediate gearing 86 comprises first gear 92 (FIG. 6) which intermeshes with segmental gear 94, which in turn is mounted on plate 78 of hub 74 of the oscillating arm means. Intermediate gearing 86 further includes a second larger gear 98 for meshing with driven gear 100 on output shaft 80. Step down gearing 86 serves to change the rotary speed of output shaft 80 from that of pivot shaft 66 of the oscillating arm means.

A one-way clutch 102 is mounted between shaft 84 of sheet advance drive roll 34 and output shaft 80 of output gear train 48 and serves to transmit rotary power to shaft 84 of roll 84 when output shaft 80 is turning in one direction and to disengage output shaft 80 from shaft 84 of sheet advance roll 34 when output shaft 80 rotates in the opposite direction.

As an important feature of the invention, means associated with housing 42 and gear assembly 40 are provided to permit externally changing the position of components of gear assembly 40 within housing 42 to facilitate rapid adjustment of the amount of rotation of sheet advance drive roll 34. These means generally indicated as 104 (FIG. 4) comprise a crank arm 106 (FIG. 8) within the input gear train which is welded to hollow intermediate shaft portion 124, which in turn is pinned to adjusting flange 120, which as indicated in FIG. 8 is external to housing 42. Hollow shaft portion 124 could be an integral extension of flange 120. Crank arm 106 is rotatably mounted in sleeve bearing 108 about input shaft 50, whereas bearings 59 permit crank 56 to rotate about crank or stub shaft 58 at a constant r.p.m. via gears 52 and 54. During operation of the apparatus, crank arm 106 itself remains stationary. Gear 52 is pinned at 53 to an enlargement 55 on the inner end of input shaft 50. To change the center distance d (FIG. 5) between pivot shaft 66 of oscillating arm means 49 and crank shaft 58, crank arm 106 is merely rotated on bearing 108, and since crank shaft 58 is press fitted into a bore in arm 106, such rotation will result in a movement of shaft 58 to either the right or the left (FIG. 5) depending on the direction of rotation of crank arm 106. End cap portion 107 and pin 109 insure that shaft 58 remains axially fixed in the bore of arm 106. Arm 106 is rotated externally of housing 42 by means of rod 118 (FIG. 5) pivoted at 128 to flange 120. Slots 122 in flange 120 define the limits of rotation of flange 120 and therefore the extent of adjustment. Bolts 126 are provided for securing adjusting flange 120 to the upper half of housing 42 after movement of adjusting flange 120. Rod 118 has a threaded lower portion 130 extending through a threaded hole in nut 128. Clevis 132 is pinned to housing 42 above flange 120 and surrounds collar 134, which in turn is pinned to rod 118 within clevis 132. Thus when rod 118 is manually rotated in a plane perpendicular to the axis of adjustable flange 120, rod 118 moves through the threaded hole in nut 128 so as to cause flange 120 to rotate in one direction while collar 134 pinned on rod 118 abuts against inner surfaces of the clevis and remains stationary relative to housing 42. A dial 136 which may be calibrated in terms of sheet displacement and/or the size of the articles being formed, is mounted on casing 42 adjacent adjusting flange 120. Pointer 138 on adjusting flange 120 is intermediate dial 136 and flange 120. Thus, flange 120, hollow intermediate portion 124 and crank arm 106 serves as an adjusting lever which is pivotable about input shaft 50. Flange 120 serves as a portion of the lever which is external to housing 42 and pivotally mounted rod 118 serves as the means by which an input force may be applied to the lever to change the position of stub shaft 58 with respect to pivot shaft 66 of the oscillating arm means.

Means are also provided to arrest the rotary motion of sheet advance roll 34 during the latter part of the sheet advance cycle. These means include lower cam 140 (FIG. 5) mounted by means of cam support 144 on shaft 66 of the oscillating arm means. Lower cam 140 coacts with follower 142 which in turn is conventionally rotatably mounted on the end of a short arm associated with electrical limit switch 146. Limit switch 146 is mounted on plate 152 which in turn is secured to housing 42. Magnetic brake 154 (FIG. 1) is coupled to shaft 84 of advance roll 34 on the opposite side from that connected to output shaft 80 of output gear train 48. Magnetic brake 154 is of conventional design and basically comprises a plate splined to shaft 84 perpendicular to its axis and which rotates with shaft 84. An electro magnet is fixedly mounted on the frame of the apparatus spaced a short distance from and in a plane parallel with that of the plate. On electrically energizing the magnet by means of lower limit switch 146, the magnetic force applied against the plate moves the plate toward the magnet a distance on the order of one-sixteenth inch. When this force is applied, the plate acts as a drag on shaft 84 on which the plate is mounted. Suitable conventional electric wiring is utilized to interconnect lower limit switch 146 with magnetic brake 154.

Means are also provided to operate electro-magnetic clutch-brake 20 of drive means 16 at a preselected time in the cycle. These means include upper cam 143 which is adjustably mounted on cam support 144 by means of bolt 156 movable in slot 158. Fine adjustment of the position of cam 143 is achievable by means of bolt 160. Cam 143 coacts with follower 150 which is rotatably mounted on an arm associated with upper limit switch 148 secured on plate 152 in the same manner as switch 146. Conventional electrical control wiring interconnects switch 148 with electro-magnetic clutch-brake 20.

In operation, as the upper platen 162 of the forming press (FIG. 2) starts its upward movement on completion of a forming cycle, a limit switch (not shown) which is adjustably mounted on the forming press is

energized to activate electro-magnetic clutch-brake **20** so as to disengage the brake portion thereof and to engage the clutch portion thereof. This limit switch is positioned such that it is energized by the upper platen only when the latter has cleared the uppermost portion of the formed articles which are then within the press. Otherwise if the sheet were to start to move prior to this time, the articles could catch on the tooling and be prematurely stripped from the sheet.

Thus, with the clutch engaged power is transmitted in one direction from continuously rotating variable speed motor **18** to input shaft **50** of the input gear train of the gear assembly **40**, and thence through gears **52** and **54** to the constant r.p.m. crank **56**. During this time, of course, crank arm **106** is stationary. The rotary motion of crank **56** is converted to longitudinal motion by means of slider block **62** pivotally mounted on slider block arm **60** and confined within track **70** of inside-outside arm **68**. Thus slider block **62** will move to the right (FIG. **5**) so as to cause arm **68** of the oscillating arm means to move angularly upwardly through a total angle of about 45°. This upward movement of arm **68** causes pivotal shaft **66** to rotate in a counterclockwise direction, and this rotary motion is transmitted to the output gear train by means of segmental gear **94** which is mounted on hub **74** so as to cause shaft **80** and thus shaft **84** of sheet advance roll **34** to rotate in one direction. This rotation causes the scrap portion of sheet S from which the articles have been removed to feed into the nip of rolls **34** and **36** and thus to pull an upstream portion of the sheet into the forming press. During this portion of the sheet advance cycle the linear speed of advancement of the sheet is controlled by the relation of crank **56** to arm **68** and the rotary speed of the output shaft of variable speed motor **18**. Thus, to change the rate or advance of the sheet involves merely changing the output speed of conventional variable speed motor **18**. When arm **68** is one-half way through its upward stroke, which position corresponds to the point of maximum arm velocity and the end of the accelerating portion of the cycle, cam **140** mounted on pivot shaft **66** and follower **142** energizes lower limit switch **146** so as to activate magnetic brake **154** in order to apply a drag force on shaft **84** of sheet advance roll **34**. This drag force resists and is less than the power being transmitting thereto by the drive means. Thus roll **34** is positively linked to arm **68** and decelerated during the final portion of the upward swing of arm **68**, so as to drive roll **34** during this portion of the advance. Otherwise roll **34** would freely rotate to a stop in a variable manner under the influence of its own inertia and at its own pace. Limit switch **146** may also be utilized to activate the means for lowering platen **162**, so that the relatively large platen may start downwardly to commence the next cycle before the sheet has completed its movement to minimize cycle time. An electrical timer may be utilized in the circuitry to permit an operator to synchronize the movement of the platen with that of the sheet.

After arm **68** has reached the upper limit of its cyclic swing (shown in phantom in FIG. **5**) further rotary motion of crank **56** in the same direction causes confined slider block **62** to reverse its direction in track **70** and proceed downward in the opposite direction to move into position for the start of the next cycle. This reverse movement causes pivot shaft **66** to rotate similarly in the opposite direction from that in response to the upward stroke of arm **68**, which in turn causes shaft **80** of the output gear train end shaft **84** of advance roll **34** to likewise reverse rotation. However, one way clutch **102** isolates this reverse motion from shaft **84** of the sheet advance roll **34**. Thus, since magnetic brake **154** is still energized, when arm **68** starts its downward stroke, the drag exerted by the brake in combination with the isolation provided by one way clutch **102**, terminates the rotary motion of shaft **84** and therefore the advance movement of sheet S. When arm **68** is close to the lower limit of its downward stroke defined by a horizontal position, cam **143** in cooperation with follower **150** energizes upper limit switch **148** which in turn electrically causes the brake portion of electromagnetic clutch-brake **20** to engage and the clutch portion to disengage so as to isolate the system from continuously operating drive motor **18** and thus complete one portion of the sheet advance cycle. Thus, the geometry of the gear assembly in combination with the one way clutch and the magnetic brake determine the accuracy of sheet displacement and not the position of upper cam **143**, since if the movement of arm **68** is terminated at any point along its downward stroke the extent of advance of the next cycle will be the same because power is transmitted to roll **34** as a result of one way clutch **102** only during upward movement of arm **68**. To minimize overall cycle time, however, cam **143** is set to deactivate the system just before arm **68** reaches a true horizontal position. Thereupon upper platen **162** moves downwardly to commence formation of the next series of articles if it has not already started to do so during the latter portion of the sheet advance as previously described. During forming, magnetic brake **154** remains energized so as to positively prevent sheet advance roll **34** from moving even slightly, which of course would be undesirable with respect to the forming operation. Brake **154**, however, is de-energized by the limit switch which determines the start of the cycle so as to permit the sheet advance roll to be driven unimpaired during the acceleration portion of the advance cycle. Brake **154** in combination with the switches which energize and de-energize it thus provides positioning accuracy in the system without sacrifice in indexing speed since it is utilized only during the deceleration portion of the cycle. After the articles are formed the upper platen **162** starts to move upwardly to start the next sheet advance cycle.

Auxiliary features of the invention may include an additional limit switch mounted on the outside of housing **42** and activated by lower cam **140** to detect that the sheet has completed its forward advance. This limit switch would prevent upper platen **162** from completing its downward stroke until the sheet has stopped its advance movement, or in other words would not allow platen **162** to complete its downward stroke unless arm **68** of the Geneva assembly has reached the upper extremity of its stroke. This feature avoids forming on a moving sheet.

Gear assembly **40** must be in a stationary condition when it is desired to change the extent of sheet advance. Bolts **126** are merely loosened and rod **118** pivoted one way or the other to change the center

distance between crank shaft 58 about which crank 56 rotates and pivot shaft 66 of the oscillating arm means. This in essence changes the starting position of slider block 62 in track 70 of arm 68 and therefore alters the extent of the angular rotation of arm 68, which in turn accordingly alters the amount of rotation transmitted to shaft 84 of sheet advance roll 34. The new position is fixed by again securing bolts 126 to housing 42.

An alternative embodiment of the invention is illustrated in FIG. 7 wherein pivotally connected arm 164 of the oscillating arm means reciprocates through slide 172 having bushings 168 therein, and a hollow portion 170 of pivot shaft 166 in response to the rotary motion imparted through crank arm 60 and gear 54, the latter being constructed similarly to that shown in the preferred embodiment.

The above description and particularly the drawings are set forth for purposes of illustration only and are not to be taken in a limited sense.

The apparatus of the present invention is applicable to transfer cyclic power to an output shaft which preferably is on a sheet advance roll in an assembly wherein movement of the sheet across a peripheral portion of the roll is smooth and variable. Since the sheet being advanced by the roll contacts a rather large surface area of the advance roll, it is especially effective in applications where large articles have been previously formed in and removed from the sheet. The constant angular velocity of the rotating crank in the input gear train of the system is converted via the oscillating arm means to a gradually increasing velocity of the sheet advance roll then a relatively constant portion followed by a gradual decrease which is approximately equivalent to that of the increase.

Although the invention has been described with reference to preferred embodiments, it will be apparent to those skilled in the art that the invention is not limited to the embodiments specifically illustrated in the drawings. Those skilled in the art with the benefit of this invention, may readily envision additions, deletions, substitutions and modifications which would be consistent with or equivalent to the form of the invention herein described.

We claim:

1. Apparatus for transmitting cyclic power to an output shaft comprising:
   - A. a unidirectional input rotary drive shaft;
   - B. a constant r.p.m. crank operatively connected to the input shaft;
   - C. oscillating arm means including:
     - a. a pivot shaft;
     - b. an arm fixedly mounted on the pivot shaft;
   - D. a slide block pivotally connecting the crank to the arm to convert the rotary motion of the crank to oscillatory motion of the arm;
   - E. means for transmitting the motion of the pivot shaft to the output shaft; and
   - F. means for changing the center distance between the crank and the pivot shaft where by the oscillatory stroke of the arm and the output shaft may be changed.

2. The apparatus of claim 1 wherein the means for changing the center distance includes adjusting lever means having a portion pivotable about the input rotary drive shaft.

3. The apparatus of claim 2 including a housing for the apparatus and wherein said portion of the lever means is external to the housing, said apparatus further including a rod pivoted to the external portion of the lever means through which an input force may be applied to alter said center distance.

4. The apparatus of claim 2 including a housing for the apparatus and wherein said lever means comprises:
   - a. a crank arm;
   - b. a stub shaft fixed on said crank arm and rotatably supporting said crank;
   - c. a hollow intermediate shaft surrounding said input drive shaft and secured to said crank arm; and
   - d. a slotted adjusting flange external of and releasably secured to said housing, said flange being fixed on said intermediate shaft and adapted to be rotated about said input drive shaft to the extent of the length of said slots to thereby move the stub shaft and crank with respect to the pivot shaft of the oscillating arm means.

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