Sept. 15, 1953

B. S. KAGAN

2,652,246

FOLDING MACHINE CONTROLS

Filed May 8, 1953

6 Sheets-Sheet 1

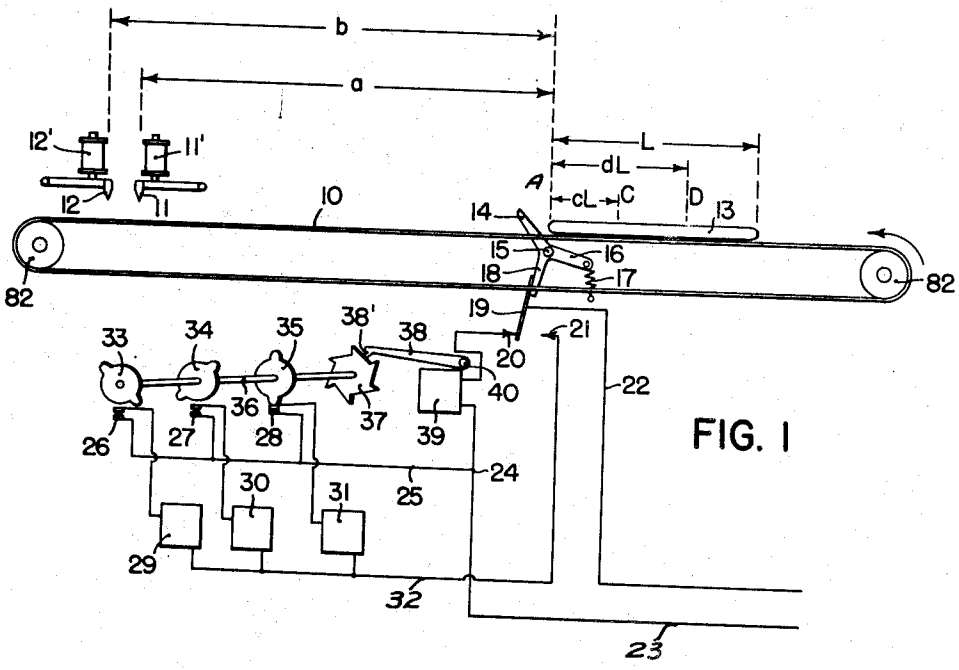

FIG. 1

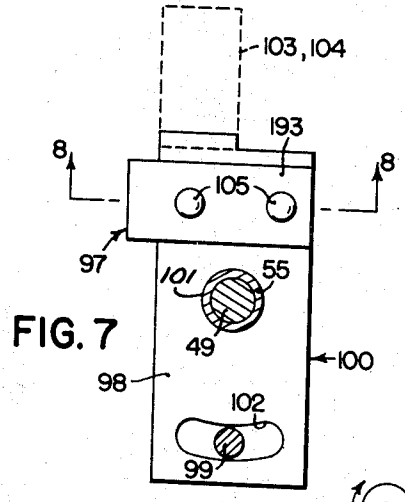

FIG. 7

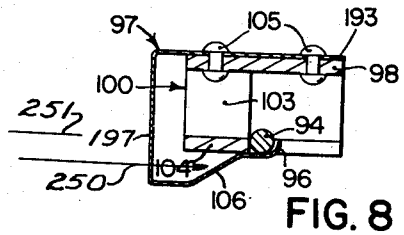

FIG. 8

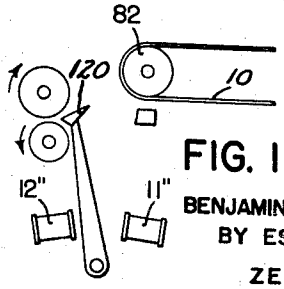

FIG. 1a

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FOLDING MACHINE CONTROLS

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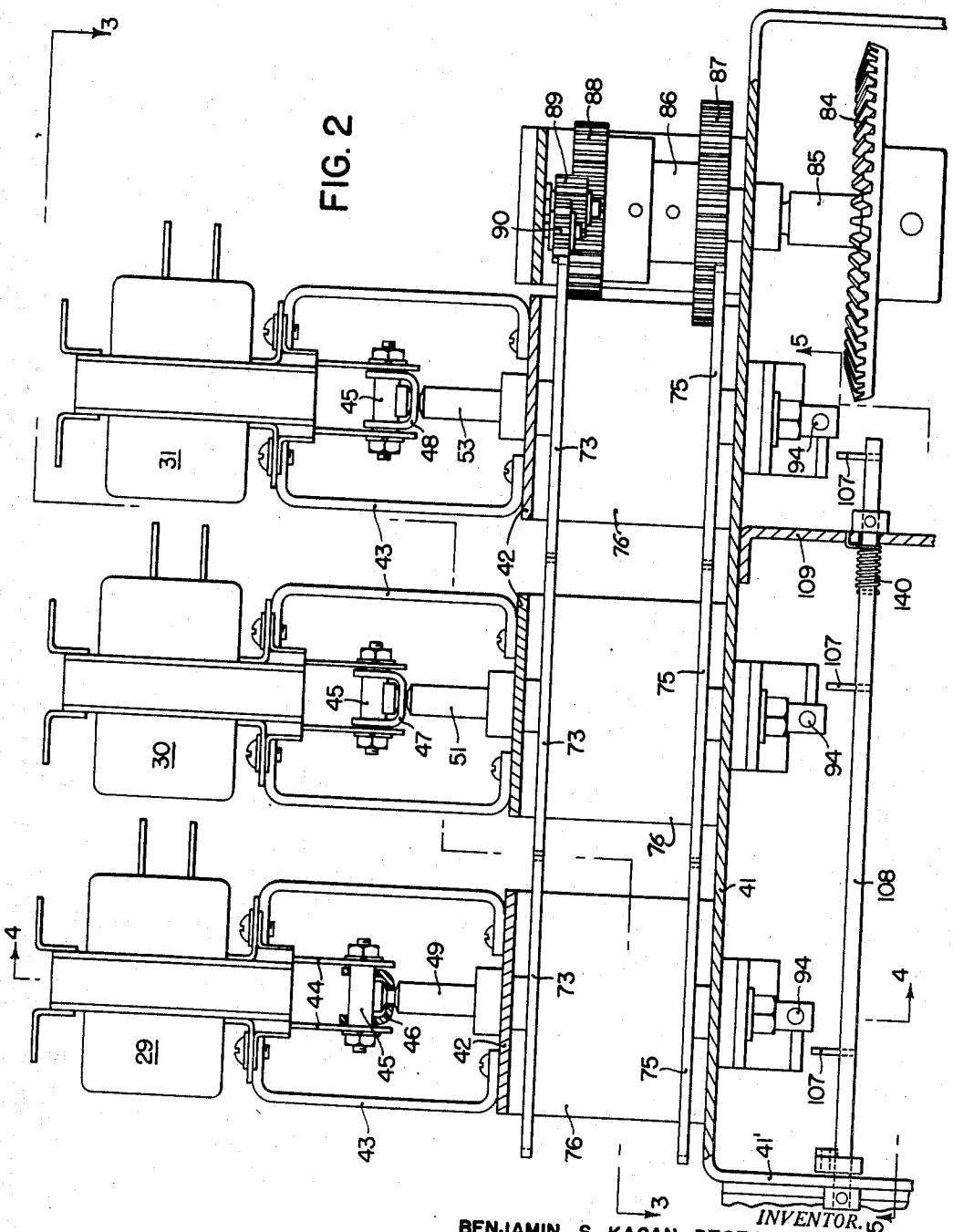
6 Sheets-Sheet 2

FIG. 2



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6 Sheets-Sheet 3

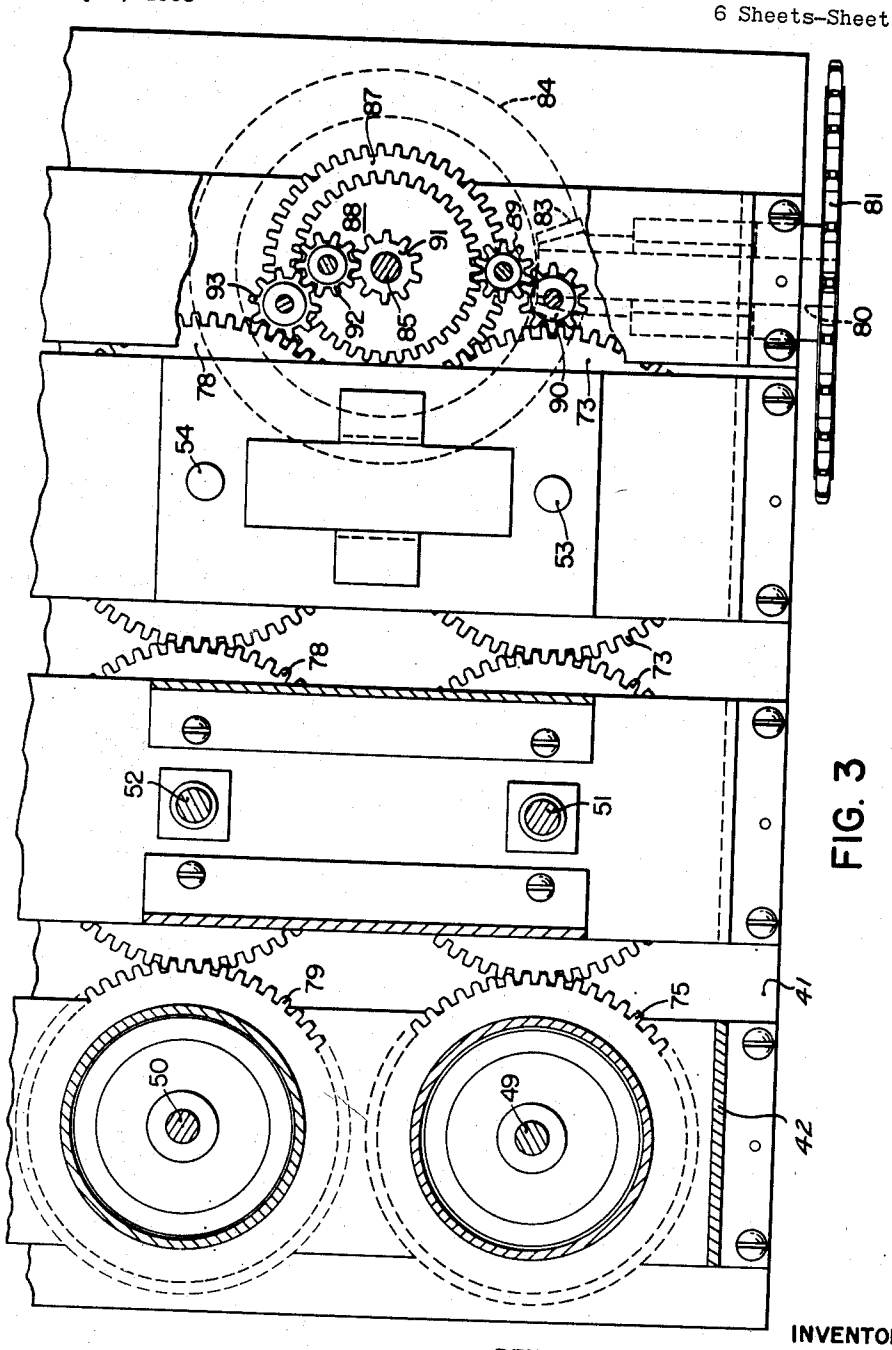

FIG. 3

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FOLDING MACHINE CONTROLS

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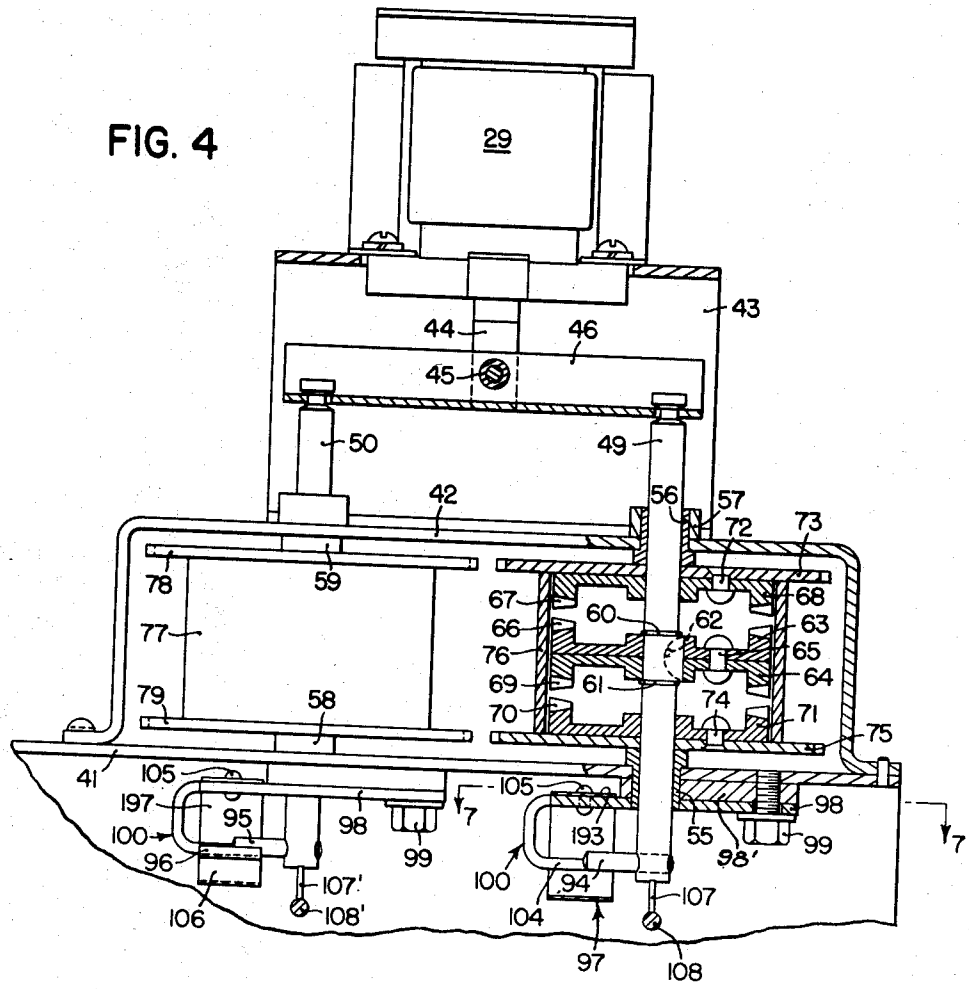
6 Sheets-Sheet 4

FIG. 4



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2,652,246

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6 Sheets-Sheet 5

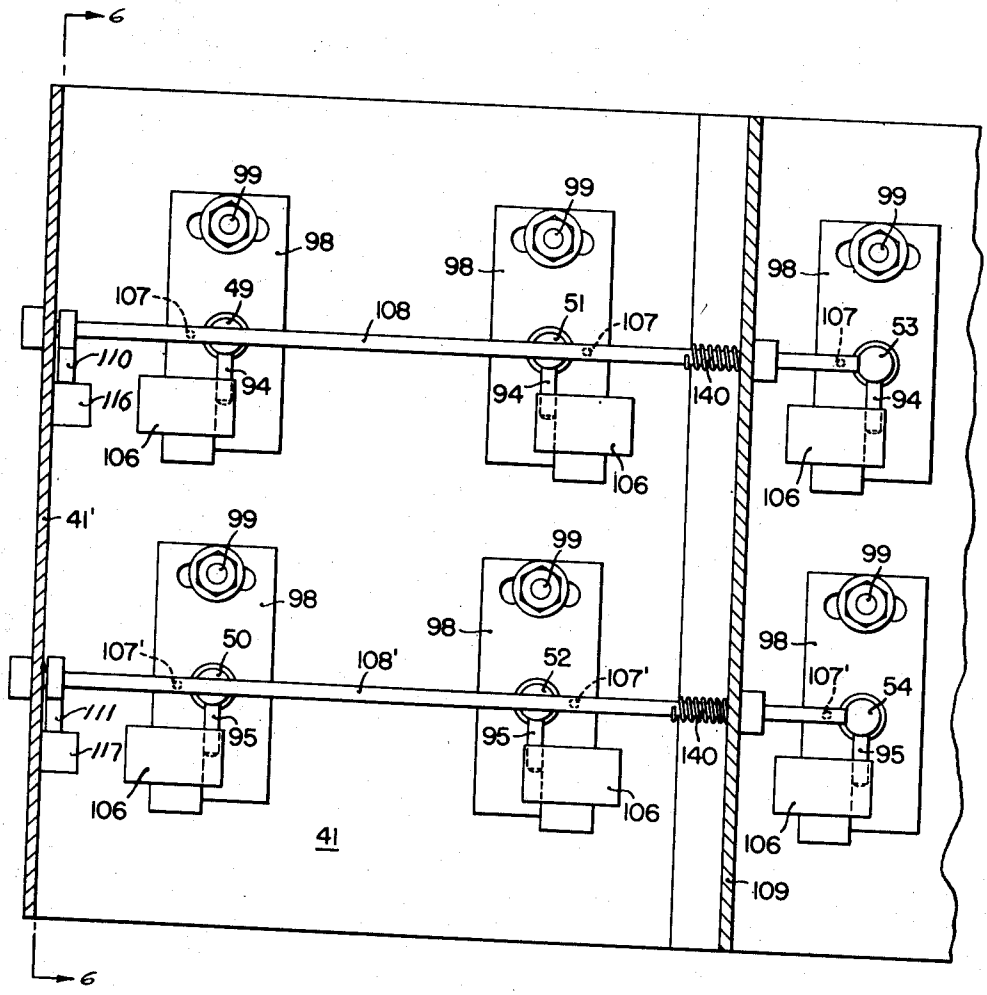

FIG. 5

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2,652,246

Filed May 8, 1953

6 Sheets-Sheet 6

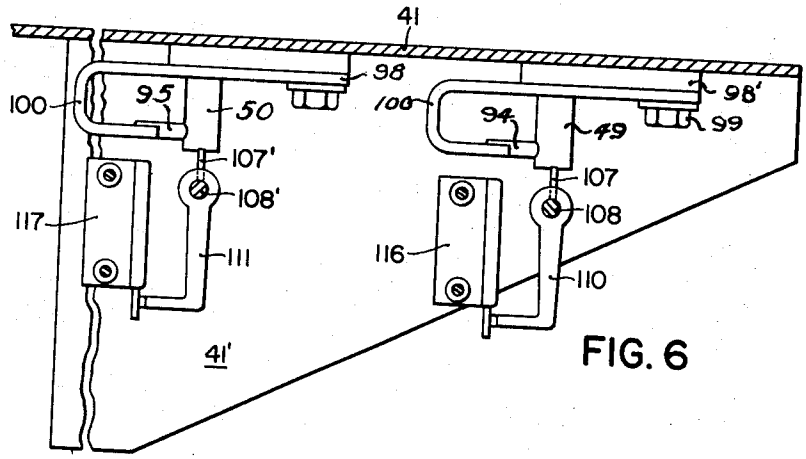

FIG. 6

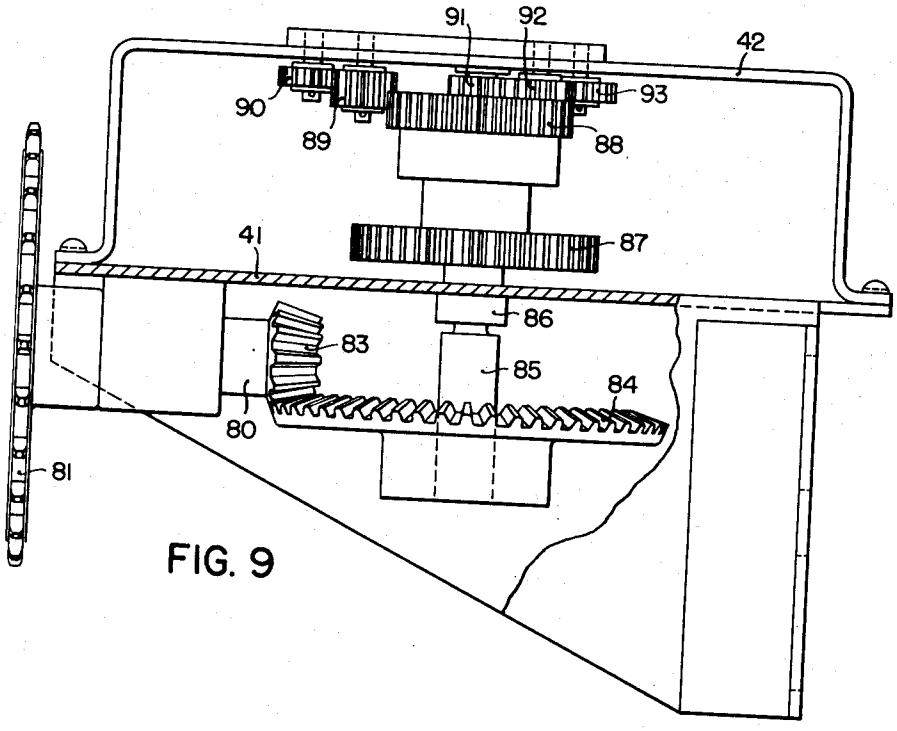

FIG. 9

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Patented Sept. 15, 1953

2,652,246

UNITED STATES PATENT OFFICE

2,652,246

FOLDING MACHINE CONTROLS

Benjamin S. Kagan, deceased, late of Rock Island, Ill., by Esther E. Kagan and Zena S. Kagan, Rock Island, Ill., heirs, assignors to American Machine and Metals, Inc., New York, N. Y., a corporation of Delaware

Continuation of application Serial No. 722,252, January 15, 1947. This application May 8, 1953, Serial No. 353,872

32 Claims. (Cl. 270—81)

1

This is a continuation application of application Ser. No. 722,252, and this invention relates to folding machine controls, and more particularly to means for automatically locating on articles, which may vary in length and are carried on a conveyor, points that represent definite fractions of the length of each particular article, e. g., the quarter point, the mid point, or the three quarter point. These articles may be of foldable nature, such as bed sheets, in which case the means for locating said points may be combined with means for folding the article at the points located.

More particularly the invention relates to the timing means required to provide for such a delay in the actuation of the locating or folding means that the actuation takes places when the desired proportional point of the sheet or the like arrives at the locating or folding device.

In machines of this kind the locating or folding device is to be arranged some distance beyond a measuring element which is controlled by the travelling article to be marked or folded itself. During the time the article travels in contact with said measuring element the timing mechanism times the means for actuating the locating or folding device in such a manner that that device will become actuated at the moment when a desired fraction of the length of the article, such as a quarter thereof, has just passed beyond this locating or folding device. Where there is a second locating or folding device, the correction in the timing of the means which are to actuate the second locating or folding device is such that the actuation of that second locating or folding device will not take place before a second point of the article, representing another fraction of the length thereof, such as one half or three quarters, has reached said second locating or folding device.

In certain hitherto known sheet folding machines timing means are used which include a plurality of driving means each operating at a different speed, the ratio of these speeds being proportional to that part of the delay to be imposed on the locating or folding means by the particular timing means because of the length of the article.

It is an object of this invention to provide in a machine of the general character mentioned timing means including an axially displaceable timing spindle which is positively driven at either of two speeds by the temporary engagement of one of several gears carried by said spindle with one of several driving gears which are permanently driven at speeds bearing a desired speed relationship to each other.

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Another object of the invention is to provide a plurality of timing devices, each complete in itself, which are started for successive and independent operation as articles to be measured, e. g. bed sheets, arrive in succession as the aforementioned measuring element.

Another object of the invention is to provide a method of dividing articles of varying length into equal parts wherein the length of each article is measured by an individual timing unit and several individual timing units are put into operation in succession by the arrival of one article after the other at a fixed measuring point and another timing unit is pre-conditioned for operation each time one of these timing units has finished its measuring action.

Another object of the invention is to provide a sequence relay for putting into readiness for operation one of several separate timing devices after another, whenever an article, e. g. a sheet to be folded, leaves the measuring element.

It is another object of the invention to provide in each timing device a pair of timing units and to put those pairs of timing units under the control of a sequence relay to condition a different pair of timing units for subsequent operation each time a sheet or the like article leaves the measuring element.

It is a further object of the invention to provide in a timer a vertical spindle which is axially displaceable between an upper, an intermediate, and a lower position and which is lifted from its intermediate position into its upper position by means of a lifting solenoid, whereas it assumes its lower position under the action of gravity when it is released by said lifting solenoid.

Still a further object of the invention is to provide a common lifting solenoid for a pair of timing units so that both units of that pair will start their operation simultaneously.

It is another object of the invention to provide means for supporting the vertical timer spindle in its intermediate position of height in a predetermined angular position into which intermediate position the timer spindle is elevated only after the spindle has performed a full revolution from its starting point.

Another object of the invention is to connect the timing shafts of the pair of timing units coordinated to one lifting solenoid by means of a beam pivotally mounted on the armature of the lifting solenoid so that the two timing shafts may be returned from their lower position to their intermediate position of height at different times.

Other objects and features of the invention will

appear as the description proceeds, reference being had to the accompanying drawings, which show, by way of example, the invention in its application to sheet folding machines, and in which:

Fig. 1 shows in a diagrammatic manner an electric circuit for a plurality of timer units with means for successively selecting and actuating these units, two separate folding means being indicated as being controlled by these units;

Fig. 1*a* shows a modification using a single folding knife for producing a plurality of folds;

Fig. 2 shows in an elevational view, partly in section, one constructional embodiment of the invention;

Fig. 3 is a horizontal section along the line 3—3 in Fig. 2;

Fig. 4 is a vertical section along the line 4—4 in Fig. 2;

Fig. 5 is a sectional bottom view on the line 5—5 in Fig. 2;

Fig. 6 is a vertical section on line 6—6 in Fig. 5;

Fig. 7 is a sectional plan view on the line 7—7 in Fig. 4;

Fig. 8 is a section on the line 8—8 in Fig. 7; and

Fig. 9 is a side elevation of the drive shown at the right end of Figs. 2 and 3.

Referring first to Fig. 1, 10 denotes a conveyer belt which is driven in the direction of the arrow shown at the right end of Fig. 1. An article 13, e. g. a bed sheet, fed to the conveyer belt 10 from the right will be carried by the belt towards the left under locating or folding members indicated at 11 and 12. Extending into the path of the article 13 as it is carried along by the belt 10 is a finger 14 which forms one arm of a three-armed lever pivoted at 15 and having arms 14, 16, 18. To the second arm 16 of that three-armed lever a spring 17 is attached, whereas the third arm 18 carries a switch element 19. The spring 17 tends to keep the three-armed lever 14, 16, 18 in the position shown in which the switch element 19 rests against a fixed contact 20. Upon the front end of a sheet 13 carried along by the conveyer belt arriving at the finger 14 from the right the sheet depresses this finger, whereby the three-armed lever 14, 16, 18 is swung about the pivot 15 in counter-clockwise direction against the action of the spring 17. The element 19 is thereby moved away from the contact 20 to make contact with another fixed contact 21. The switch element 19 is connected by means of a conductor 22 to one terminal of an electric current supply whose other terminal is connected by a conductor 23 to a point 24 from which a conductor 25 leads to switches 26, 27 and 28 arranged in parallel. Each of the switches 26, 27, 28 is connected in series respectively to one of three solenoids 29, 30, 31, which are arranged in parallel between the conductor 25 and a conductor 32, the latter connecting to the contact 21.

The switches 26, 27, 28 are normally open and each may be closed by means of one of three cam disks 33, 34 and 35 secured to a shaft 36. Each cam disk 33, 34, 35 is provided with at least one cam and in the example shown comprises two diametrically arranged cams. The radial positions of these cams are so staggered that each cam disk 33, 34, 35 will close its coordinated switch 26, 27, 28, respectively, in a different radial position of the shaft. Secured to the shaft 36 is also a star or ratchet wheel 37 which has six

teeth and is actuatable by means of a pawl 38' forming part of, or secured to, the armature 38 of a solenoid 39. The armature carrying the pawl 38' is pivoted at 40. One end of the winding of the solenoid 39 is connected to point 24 of the conductor 25, whereas the other end of said solenoid winding is connected to contact 20.

When the finger 14 is depressed from its raised position the switch element 19 establishes a circuit extending from the one terminal of the current source through the line 22, switch element 19, contact 21, lead 32, through that particular solenoid 29, 30, or 31 which happens to be inserted into the circuit depending on which switch 26, 27, or 28, is closed at the time, and through the conductors 25 and 23 back to the current source. In the position of the parts shown in Fig. 1, cam 35, which is coordinated to solenoid 31, keeps the switch 28 closed, whereas cams 33 and 34 permit the switches 26 and 27 to stay open, leaving the solenoids 29 and 30 de-energized. The finger 14 remains depressed as long as the sheet 13 is travelling over that finger. When the rear end of the sheet 13 leaves the finger 14 the three-armed lever 14, 16, 18 is free to be turned clockwise by the spring 17 whereby the switch element 19 carried by the arm 18 breaks the contact at 21 and establishes contact at 20. This cuts out all three solenoids 29, 30, and 31 and establishes a circuit extending from the one terminal of the current source through the lead 22 to the switch element 19, through said element 19 to contact 20 and from here through the solenoid 39 and the conductor 23 back to the current source. The solenoid 39 being thus energized pulls down its armature 38 which by means of the pawl 38' turns the star wheel 37 one tooth. Thereby the shaft 36 is turned a certain angular amount, in the example shown 60°, which brings the cams 33, 34, and 35 into a position in which they open switch 28, close switch 26, and leave open switch 27. Upon the arrival of another sheet 13 at the finger 14, the latter is pressed down again, moving the switch element 19 to contact 21. Since now, on account of the switch 26 being closed, the solenoid 29 is inserted into the circuit, this solenoid 29 will become energized and remain so energized until the rear end of the sheet 13 passing over the finger 14 leaves the latter and thereby permits the spring 17 to move the switch element from contact 21 to contact 20. In so switching from contact 21 to contact 20, the switch element 19 breaks the circuit containing the solenoid 29 and re-establishes the circuit through the solenoid 39. The latter, by operating the pawl 38', turns the star wheel 37 and the parts connected thereto for another 60° angle, preconditioning thereby another of the three solenoids 29, 30 and 31, in this case the solenoid 30.

Each of the three solenoids 29, 30 and 31 forms part of a separate timing device, the three timing devices to be put into operation in succession and each timing device actuating a number of folding devices. In Fig. 1 two folding devices 11, 12 are shown, each timing device operating a solenoid 11' coordinated to folding device 11 when one predetermined point of a sheet 13 or the like arrives under that folder 11 and a solenoid 12' coordinated to folding device 12 when another predetermined point of that sheet arrives under the folder 12.

It is to be noted that while the invention is shown in Fig. 1 as controlling two independent devices, 11, 12, the apparatus could actuate additional devices by making each solenoid control

more than two timing devices. The invention is likewise applicable to that type of folding machine having a single folding knife that assumes two folding positions, such as is shown in Patent No. 1,607,407. In this type of folding machine the single folding knife, as shown in Fig. 1*a* at **120**, may be drawn into one position by an operating member shown in Fig. 1*a* as a magnetic coil **11''** and drawn into the other position by another operating member, here shown as a magnetic coil **12''**. To each coil **11''** and **12''** of Fig. 1*a* belongs a set of timing units in the same manner as has been described in connection with the coils **11'** and **12'** shown in Fig. 1.

In the following description of Figs. 2 to 9 it is assumed that the folders **11** and **12** shown in Fig. 1 or **120** shown in Fig. 1*a* are to be operated so that folder **11** is actuated, or folder **120** is moved into one of its two active positions, when the first quarter of the length of the sheet **13** to be folded has passed beyond said folder **11** or the first position of folder **120**, whereas a second fold is made by the folder **12** in the case of Fig. 1, or by the folder **120** in the case of Fig. 1*a*, when ¾ of the length of the sheet **13** have passed beyond said folder **12** or **120**, respectively. Since there is a plurality of solenoids **29, 30, 31** coordinated to the folding device **120** or devices **11, 12**, which solenoids act in succession, a second or third sheet may pass the length measuring finger **14** without waiting until the first timing unit has completed the task of folding the first sheet and that sheet has completely passed through the folding machine. The sheets to be folded may, therefore, follow each other as closely as desired.

Regardless of which of the three solenoids **29, 30, 31** is inserted into the circuit, the locating or folding devices are actuated in the same manner on the basis of a delayed timing which not only enables the front end of the sheet or other piece of work **13** to travel from the measuring point **14** to the locating or folding points **11** and **12**, respectively, but also to properly position first the first folding point of the sheet or the like in register with the first locating or folding device and then successively following folding points in register with successive locating or folding devices so that the sheet or the like will be divided into the parts desired. In Fig. 1, C denotes the point of the piece **13** at which a first fold, and D the point at which a second fold is to be made. The first folding is to be carried out upon energization of the coil **11'** (or the coil **11''** in the case of a folding device of the kind shown in Fig. 1*a*) and the second folding upon energization of the coil **12'** (or **12''**). The distances of the points C and D from the front end A of the sheet **13** are indicated as *c*L and *d*L, wherein L denotes the length of the sheet to be folded and *c* and *d* are constants depending upon the type of the folding devices used and the number of folds desired. To reach the locating or folding device **11** the front end A of the sheet **13** has to travel the distance *a* and to reach the device **12** the distance *b*, which distances are to be chosen great enough to permit the mechanism to take into account, prior to the actuation of the devices **11** and **12**, the maximum length of sheets **13** the machine is supposed to handle.

In the structural embodiment of the invention shown in Figs. 2 to 9 there are mounted on a base plate **41** three frames **42** supporting each an intermediate frame **43**. Upon each frame **43** one of the solenoids **29, 30,** and **31** is mounted. Each of these solenoids has an armature **44** carrying a pin **45** at its lower end. Each pin carries a U-shaped beam **46, 47** and **48**, respectively. Whenever one of the three solenoids **29, 30,** or **31** is energized, one of the three beams **46, 47,** or **48** is elevated. Each of the beams **46, 47, 48** controls the vertical position of a pair of vertical spindles, beam **46** being connected with spindles **49** and **50**, beam **47** with spindles **51** and **52**, and beam **48** with spindles **53** and **54**. Since the three timing mechanisms coordinated to the three solenoids **29, 30, 31** are of identical construction only the timing mechanism which belongs to one of the three solenoids **29, 30, 31**, namely solenoid **29**, and which is shown in Fig. 4, will be described in detail.

According to Fig. 4, the spindle **49** is journalled in the base plate **41** by means of a bushing **55** and in the frame **42** by means of a bushing **56** inserted into a collar **57** formed on the frame **42**. Similar bushings **58** and **59** are provided for the spindle **50**. Secured to the spindle **49** by means of an upper collar **60**, a lower collar **61**, and a key **62** are two coupling members **63** and **64** which may be held together by rivets **65** or be otherwise so connected as to act in unison. The coupling member **63** is in the form of a face gear **66** adapted to mesh with a face gear **67** of an upper counter coupling member **68**, whereas the lower coupling member **64** has a face gear **69** adapted to engage a face gear **70** formed on a lower counter coupling member **71**. The upper counter coupling member **68** is secured by rivets **72** to a gear **73**, whereas the lower counter coupling member **71** is attached by means of rivets **74** to a gear **75**. Between the gears **73** and **75** there is arranged a cylindrical sleeve **76** surrounding the coupling members and counter coupling members just mentioned and a similar sleeve **77** extends between an upper gear **78** and a lower gear **79** arranged coaxially with the spindle **50**. The gears **73, 75, 78** and **79** are all driven from a shaft **80** which carries a sprocket wheel **81** (Fig. 3 and Fig. 9). This sprocket wheel may be driven by a sprocket chain which is not shown and which may connect to the pulley **82** indicated in Fig. 1 in order to rotate the shaft **80** at a speed which is always proportional to the speed at which the work **13** to be folded travels. The shaft **80** carries a bevel pinion **83** which meshes with a bevel gear **84** on a vertical shaft **85**. Fastened to the shaft **85** is a hub **86** of a gear **87** which engages the gear **75**. Thus the gear **75** below the sleeve **76** is constantly rotated at a speed that may be called "full speed," it being understood that this "full speed" varies as the speed of the travelling belt that carries the work under the finger varies. Another gear **88** of smaller diameter than gear **87** is secured to the same shaft **85** and, by means of idlers **89** and **90**, rotates the gear **73**. In Fig. 3 gear **73** lies directly above gear **75**. In the example shown, the diameter of the gear **88** is chosen 75 per cent of the diameter of the gear **87**, in order to rotate the upper gear **73** at a speed which is 75 per cent of the speed at which the lower gear **75** revolves. Still another gear **91** is fastened to the shaft **85**, the diameter of the gear **91** being 25 per cent of that of the gear **87**. By means of idlers **92** and **93** the gear **91** rotates the upper gear **78** surrounding the shaft **50** at one-fourth of the "full speed." The lower gear **79** surrounding the shaft **50** is driven from the same gear **87** which drives the lower gear **75** surrounding the shaft **49** so as to revolve at the same "full speed" as gear **75**.

Fig. 4 shows the spindles **49** and **50** in the inter-

mediate or neutral position of height in which they are held mechanically in a manner to be described later. When the spindles 49, 50 are in this intermediate position their coupling members 63 and 64 are out of contact with the upper counter coupling members 68 as well as with the lower counter coupling members 71. Upon the solenoid 29 becoming energized in the manner described above in connection with Fig. 1, it raises, by means of its armature 44, the beam 46 which carries with it both spindles 49 and 50. Thereby the face gears 66 of the upper coupling members 63 of both spindles 49 and 50 are lifted into engagement with the face gears 67 which are secured to the upper gears 73 and 78. Since the gear 73 is revolving at three-quarter speed the spindle 49 is rotated at that three-quarter speed and since gear 78 is revolving at one-quarter speed, the spindle 50 is rotated at this one-quarter speed. When the rear end of the sheet to be folded leaves the finger 14 the solenoid 29 is deenergized, permitting the armature 44 with all the parts carried thereby to drop under the action of gravity. This brings the face gears 69 of the lower coupling members 64 of both spindles 49, 50 into engagement with the corresponding face gears 70 attached to the lower gears 75 and 79. Since these gears 75 and 79 are revolving at the "full speed" both spindles 49 and 50 are now driven at that full speed.

From the foregoing it will be seen that the spindles 49 and 50 move in unison from the intermediate or neutral positions of height to an upper end position as well as from this upper position to a lower end position. The movement from the lower end position to the intermediate or neutral position, however, takes place independently for the two spindles 49 and 50, as will be described in detail later on.

The spindle 49 carries near its lower end an arm 94 and a similar arm 95 is secured to the lower end of spindle 50. When the spindles 49 and 50 are in their intermediate position of height, shown in Fig. 4, the arms 94 and 95 each rest on a cradle-shaped end portion 96 of a resilient member 97 the other end of which is secured to a bracket 100. This bracket comprises an upper plate 98 which by means of a clamp-bolt 99 is secured to the base plate 41 of the machine. A spacer 98' is placed between plate 98 and plate 41 and held in place by the same bolt 99. Confining the description for the moment to the parts cooperating with the spindle 49, the nature and arrangement of the parts cooperating with the spindle 50 being the same, it will be seen that in the plate 98 there is provided a hole 101 for the passage of the sleeve 55 surrounding the spindle 49 and also a slot 102 through which the clamp-bolt 99 extends. This arrangement allows adjustment of the bracket 100 about the axis of the spindle 49. A vertical leg 103 and a lower horizontal leg 104 of the bracket 100 are of smaller width than the upper plate 98. The portions 103 and 104 of the bracket 100 may be formed in one piece with the upper plate 98, such as by bending the whole bracket from a flat plate which before the bending has the outline shown in Fig. 7. That part of the plate which is intended to provide the portions 103 and 104 is shown in dotted lines. This dotted part of the plate is first bent down to form the vertical portion 103 and then the end portion is bent forwardly to form the portion 104.

The resilient member 97 has an upper horizontal part 193 which is secured to the upper plate 98 of the bracket 100, such as by rivets 105, and extends beyond the width of that plate 98 at one side thereof so that a vertical leg 197 extends at a distance from the bracket 100 down to a point below the lower horizontal leg 104 of the bracket 100. A portion 106 extending upwardly and forwardly connects the vertical leg 197 of the resilient member 97 with the cradle-shaped end portion 96 thereof, the latter normally contacting the lower inner edge of the leg 104 of the bracket.

The arm 94 has for its purpose to actuate one of the folding devices 11, 12 when the spindle 49 carrying the arm 94 has travelled from its initial angular position it assumes when the spindle 49 is in the neutral or intermediate position of height to another fixed radial position. This second fixed radial position is determined by a pin 107 (Fig. 2) which is carried by a rock shaft 108 supported at one end in a downwardly extending leg 41' of the base plate 41 and near its other end in a downwardly extending wall 109 secured to said base plate 41. A spring 140 anchored in the wall 109 tends to keep the rock shaft 108 in, or return it to, the radial position in which the pin 107 extends vertically. As will be seen from Fig. 5 there are two such rock shafts, the shaft 108 and another shaft 108'. The shaft 108 carries three pins 107 and the shaft 108' three pins 107' so that there is a separate pin for each of the spindles 49, 50, 51, 52, 53 and 54.

In the course of a complete revolution of the spindle 49 the arm 94 connected to that spindle will engage its coordinated pin 107 on shaft 108 at a particular point of this complete revolution, provided the spindle is in its lower end position, whereas the arm 95 carried by spindle 50 will engage its coordinated pin 107' on shaft 108' upon reaching a predetermined angular position in the course of its revolution, which at this time is taking place independently of the spindle 49. When the arm 94 strikes the pin 107 the rock shaft 108 is rocked and engagement of the pin 107' by the arm 95 rocks the rock shaft 108'. The rocking of the shaft 108 may be used to close a circuit which operates the folding device 11, whereas rocking of the shaft 108' causes closing of a circuit which operates device 12.

The angular distance existing between the arm 94 on the spindle 49 in the position of rest of the latter and the pin 107 on the rock shaft 108 as well as the corresponding angular distance between the arm 95 on spindle 50 and the pin 107' on rock shaft 108' are adjusted, or to be adjusted, so that the first named angular distance is proportional to the distance a in Fig. 1 and the second named angular distance to the distance b. Let it be assumed for the purpose of explanation that the length L of the piece 13 to be acted upon by the locating or folding devices 11 and 12 be infinitestimal, then this piece would have to travel the distance a from the measuring point 14 to be in position for the first locating device 11 to act and the distance b for the second locating device 12 to act. Accordingly, the device is to be so adjusted that the arm 94, travelling at full speed, would reach the pin 107 when a piece of infinitesimal length would have passed from the measuring finger 14 under the locator or folder 11 and so that the arm 95, travelling at the same full speed, would reach the pin 107' when the piece would have arrived under the locator or folder 12. Of course, the piece 13 always has a finite length and this makes it necessary to slow down the travelling speed of the arms 94 and 95

while the piece 13 is passing the measuring point 14. When thus slowed down the speeds of arms 94 and 95 are as *c* to *d*, if the two locating or folding devices 11 and 12 are to act on the points C and D, as has been explained above in connection with Fig. 1.

Where, as in the example shown in Figs. 2, 3 and 9, the diameter of the gear 88 is chosen 75 per cent and the diameter of the gear 91 25 per cent of the diameter of the gear 87, the two constants *c* and *d* are 25 per cent and 75 per cent respectively. Thus, the spindles 49 and 50 rotate each at a fixed and different slower rate of speed, while the piece 13 is passing the point 14, than they do thereafter. In this manner the time at which the arm 94 reaches the pin 107 is delayed so that the portion cL of the piece has passed beyond the locating or folding device 11 just when the arm 94 hits the pin 107. Similarly, the time when the arm 95 hits the coordinated pin 107′ is delayed sufficiently so that at this time the portion *d*L of the length L of the piece 12 has passed beyond the locating or folding device 12.

Fig. 6 shows by way of example a micro-switch arrangement which may be used for actuating the folding devices 11 and 12 in succession. The rock shaft 108 carries a crank arm 110 and the rock shaft 108′ a crank arm 111. Crank arm 110 actuates micro-switch 116 belonging to a circuit operating coil 11′ of the folding device 11, whereas a switch 117 coordinated to the coil 12′ of folding device 12 is actuated by the crank arm 111. It will be obvious that instead of two separate micro-switches, each operated by one of the two rock shafts 108 and 108′, one micro-switch may be used which is common to both rock shafts and is operated twice in succession to actuate first the folding device 11 and then the folding device 12. The micro-switch arrangement just described in connection with coils 11′ and 12′ of Fig. 1 will act in analogous manner when used in connection with the coils 11″ and 12″ of Fig. 1*a* opening the folding knife 120.

The operation of the machine is as follows:

Let it be assumed that the cam disks 33, 34 35 are in such a position that the switch 26 is closed by the cam 33, whereas the switches 27 and 28 are open. The spindles 49 and 50 are in their intermediate position of height with their arms 94 and 95 resting in the cradle-shaped end portion 96 of the respective coordinated resilient members 97.

When the front end of a sheet 13 placed on the right end of the conveyer belt 10 reaches the finger 14 it depresses this finger so that the switch element 19 is removed from contact 20 and makes contact at 21. This closes the circuit for the solenoid 29 and the latter attracts its armature 44 elevating thereby the beam 46 together with both spindles 49 and 50 into their upper position. Thereby the spindle 49 is coupled with the gear 73 and the spindle 50 with the gear 78. Both spindles 49 and 50 start revolving, the spindle 49 at the rate of the gear 73, which in the example shown is three-quarters of the full speed, and the spindle 50 at the speed of the gear 78 which is one quarter of the full speed. Both spindles 49 and 50 keep on revolving until the rear end of the sheet 13 leaves the finger 14. During the time the sheet 13 is passing over the finger 14 the two spindles 49, 50 carry around their arms 94 and 95, respectively, for unequal fractions of a full revolution. While the absolute amounts of the angular displacements of the two arms 94 and 95 depend on the length of the particular sheet passing over the finger 14, these two angular displacements always maintain the same ratio to each other, in the structural embodiment shown the ratio 3:1. To give an example: If in the position of rest the angular distance between the arm 94 and the coordinated pin 107 on rock shaft 108 is 270° and the angular distance between the arm 95 and the coordinated pin 107′ on shaft 108′ is likewise 270°, and the sheet 13 to be folded is of such length that the rear end of this sheet leaves the finger 14 when the arm 94 has travelled 180° from its starting position, then, at the same time, the arm 95 has only travelled 60°. Thus, to meet the pin 107, the arm 94 has to travel another 90°, whereas the arm 95 must travel another 210° to meet the pin 107′. It is when the arms 94 and 95 are at these different angular positions, 180° and 60°, respectively, away from the starting point, that the finger 14 is released by the sheet 13 and the switch element 19 moves from contact 21 to contact 20, breaking the circuit for the solenoid 29 and closing the circuit for the solenoid 39. The solenoid 29, being thus deenergized, loses its hold upon the two spindles 49 and 50 and since the arms 94 and 95 during the just described first phase of the rotation of the spindles 49 and 50 have been turned into a position outside of the range of the brakets 100 and the springs 97, both spindles 49 and 50 drop right down into their lowest position in which they are in engagement with the face gears 70 of the coordinated lower countercoupling members 71. These members 71 being driven both at "full speed" by the two drives 75 and 79, respectively, both spindles 49 and 50 are put into rotation at equal speed, the full speed. Since the spindle 49 starts this rotation at full speed at a point 180° away from the starting point, and the pin 107 is 270° away from the starting point, spindle 49 has to carry out a rotation of 90° until it meets the pin 107. Spindle 50, on the other hand, must cover an angular distance of 210° from the point where it starts its full speed rotational movement (60° away from the original starting point) before it reaches its coordinated pin 107′ (270° away from the original starting point). In view of this difference in the angular distance the arms 94 and 95 have to cover at the same rotational speed, arm 94 will meet its pin 107 earlier than arm 95 will hit its pin 107′, both pins 107 and 107′ extending into the respective paths of the arms 94 and 95 while the spindles 49 and 50 revolve in their lowermost position. Thus, when arm 94 reaches the angular plane in which the pin 107 stands ready to be met by this arm, it will tilt pin 107 and thereby rock the rock shaft 108. The crank arm or lever 110 on shaft 108 is thereby moved so as to close a circuit through the micro-switch 116 to energize the coil 11′ in Fig. 1 or to coil 11″ in Fig. 1*a* for making the first fold. Similarly, when arm 95 reaches pin 107′ the rock shaft 108′ will be rocked and micro-switch 117 closed to energize coil 12′ in Fig. 1 or coil 12″ in Fig. 1*a* for making the second fold.

When the spindles 49 and 50, together with their arms 94 and 95, have moved far enough from their starting position to rock their coordinated rock shafts they have served their timing function. They must, however, move on until each of these spindles has completed a full revolution in order to be ready for their next timing assignment. As each arm 94 and 95 passes beyond the point of contact with its coordinated pin 107 and 107′, respectively, the arm 94 or 95 which is

travelling along its depressed path 250 in Fig. 8 enters the space between the lower side of the horizontal portion 104 and the upper side of the portion 106 of the resilient member 107. This forces the portion 106 downward and the arm 94 continues to travel horizontally until it has passed the front edge of the portion 104 of the bracket 100. Thus the gear 64 keeps in engagement with the lower driving clutch 71 until the edge 104 is passed when the spring 106 moves the spindle 49 upwards instantaneously to the neutral level 251 which corresponds to the position of the spindle shown in Fig. 4.

The elevation of the spindle 49, by its arm 94, takes place as soon as the arm 94 reaches its initial angular position. The spindle 50 is not elevated by its arm 95 to its intermediate position until it also has reached its initial angular position. The spindles 49 and 50 are connected to armature 44 through the forced beam 46 so that, during the time interval between the elevation of each spindle the beam 46 is in an assumed inclined position, the end carrying spindle 49 being raised above the level of the pivot 45, whereas the other (left) end of the beam 46 is lowered below 45. When, then, also spindle 50 is pushed upwardly by its coordinated spring 97 the beam 46 is restored to horizontal position.

It will be seen that each spindle is first elevated from its position of rest, where it did not revolve at all, into its upper position where it is rotated at a speed of a fraction of the "full speed" for a time and an angular distance which is proportional to the length of the particular sheet to be folded, and that after that measuring phase the spindle drops into its lowest position in which it is rotated at "full speed" for the balance of a full revolution. At some intermediate point of this second phase of the rotation the arm carried by the spindle causes the making of one of the folds desired, whereupon the spindle rotates on for the purpose of reaching again its starting angular position. Having arrived there it is elevated to its intermediate position of height.

From the moment on that the solenoid which elevated its coordinated pair of spindles from the intermediate position to the upper position becomes deenergized, that is, when the sheet to be folded under the control of that first pair of spindles leaves the measuring finger 14, the further operation of said pair of spindles and the parts co-acting therewith, takes place independently of the circuit of said solenoid. Thus, another of the three solenoids 29, 30, 31 may be put into action and another sheet be measured while the first sheet is still on its way through the folding machine. As has been mentioned before, the release of the finger 14 by the rear end of the sheet which has just been measured breaks the circuit for the lifting solenoid, e. g. 29, and closes the circuit for the sequence relay 39. Energization of the relay 39 causes turning of the ratchet wheel 37 one step with the effect that the switch which was previously closed, in the example described switch 26, is opened and another switch (27) closed, leaving the third switch (28) still open. Thereby the next lifting solenoid (30) becomes pre-conditioned for operation so that it stands ready to elevate its pair of spindles (51 and 52) when the next sheet 13 reaches the finger 14 and thereby closes the circuit for said solenoid 30. There being provided three solenoids 29, 30 and 31, each forming a part of a timing unit comprising a pair of spindles, it will be obvious that each of these three solenoids measures only every third sheet reaching the measuring point 14 and that there is no practical possibility that one of these solenoids could be called into action while the timing unit belonging to that particular solenoid is still working upon a previous sheet.

The distances *a* and *b* in Fig. 1 determine the maximum length of a sheet the machine can fold for a given folding method and they are preferably chosen so that sheets of the maximum conventional length can be folded. If that maximum length be, for example, 10 ft. and the machine is to make the first fold at the first quarter point and a second fold at the third quarter point of the length of the sheet, then a distance *a* of 8 ft. between the measuring point 14 and the folding device 11 represents a quite suitable value. How the timing operates in the example mentioned will be explained now under the assumption that the belts 10 carry the sheets to be folded at a speed of 1 ft. per second. To simplify the explanation let it also be assumed that the distances *a* and *b* are equal, that is to say, that both folding devices are arranged 8 ft. beyond the measuring point 14. It will be remembered that the spindle 49, which controls the first fold, is rotated in its uppermost position at three quarters of the "full speed" at which it is driven when in its lowest position, whereas the spindle 50, which controls the second fold, is driven in its uppermost position at ¼ of the full speed at which it turns when in its lowest position. The full speed, which is the speed of the lower gears 75 and 79, is chosen so that it would take the arm 94 or the arm 95, for moving (counterclockwise) from its starting position to its coordinated pin 107 or 107', when revolving at full speed, the same time as it takes the front end of the sheet to be folded to move from the measuring point 14 to the folding point 8 ft. away from said measuring point. Since the travelling speed of the sheet 13 is 1 ft. per minute, the time just mentioned is 8 seconds. As has been described above, however, the arms 94 and 95 do not travel at full speed during the first phase of the rotation of these arms since during this measuring phase the spindles are in engagement with the reduced speed gears 73 and 78. The gear 73 running at only three quarters of the full speed, it will take the arm 94 ⅘ times as long to cover a certain distance as it would take to cover the same distance under the action of the full speed gear 75. Hence, to cover the angular distance from the starting position of the arm 94 to the location of the pin 107 would take ⅘ times the 8 seconds above mentioned, that is 10⅔ seconds. The arm 94 rotates at the three quarter speed only as long as the sheet 13 is passing over the finger 14, which for a sheet of 10 ft. travelling at the speed of 1 ft. per second means 10 seconds. At the expiration of these 10 seconds the rear end of the sheet will have reached the finger 14 so that the solenoid 29 will be deenergized and the spindle 49 will drop into engagement with the full speed gear 75. As this full speed gear needs 8 seconds to cover the full angular distance from the starting point to the pin 107, it covers ⅛ of this angular distance during each second and since in the 10 seconds which the sheet was travelling over the finger 14 the spindle 49 with its arm 94 covered 30/32 of the angular distance from the start to pin 107, there are 2/32 of this angular distance left for being travelled at the rate of ⅛ of said distance per second. This means that it takes another ½ second before the arm 94 hits the pin

107 and thereby causes the making of the first fold. Therefore, the total time which elapses from the time that the front edge of the sheet 13 reaches the measuring finger 14 and the arm 94 starts to travel until the moment that this arm 94 contacts the pin 107 is 10½ seconds. With the sheet travelling at the rate of 1 ft. per second the front end of the sheet has during this time of 10½ seconds passed 10½ ft. beyond the measuring point 14 and since the first folding device is 8 ft. beyond said measuring point 14 the front edge of the sheet is now 2½ ft. beyond the folding device. In other words, exactly ¼ of the length of the sheet has passed beyond the folding device when the latter is actuated.

During the 10 seconds it takes the sheet 13 to pass the measuring finger 14 the arm 95 on the spindle 50 travels only ⅓ the angular distance covered during the same time by the arm 94 on spindle 49. As has been shown above this distance covered by the arm 94 during the first 10 seconds is $^{30}/_{32}$ of the angular distance from starting point to pin 107 and so the angular distance covered during the same time by the arm 94 is $^{10}/_{32}$ of the distance mentioned. Therefore, the distance the spindle 50 has still to travel after the measuring period is $^{22}/_{32}$ of the total angular distance from starting point to pin 107'. Since this balance of the rotation is performed at full speed it will take the arm 95 another 5½ seconds to reach the pin 107'. This makes the total time the arm 95 has to travel from the starting point to the contact with the pin 107' 15½ seconds. In 15½ seconds the front end of the sheet 13 has travelled 15½ ft. beyond the measuring point 14 and since the second folding device is arranged 8 ft. beyond that measuring point 14, the front end of the sheet 13 is 7½ ft. beyond the folding device. Therefore, the second folding takes place exactly at the ¾ point of the sheet.

If the folding is done on the principle described in Patent No. 1,607,407, folding at the first quarter point and at the third quarter point will divide the sheet into four equal parts without any further folding operation. With other folding methods folding at the first and the third quarter point may require additional means to make another fold midway between the folds at the two quarter points described and it may be preferable to make the first fold at the half-length point of the sheet and the second fold again midway of the now already once folded sheet. To achieve this, the drive for the spindle 49 is to be modified so that the spindle is rotated at one half of the full speed when in its elevated position. With this modification there are again only two folding devices required to fold sheets into four equal parts regardless of the differences in length there might exist between the individual sheets to be folded.

It will be understood that in the example discussed above, where the time the arm 94 rotating at full speed would need to travel from the starting point to the pin 107 was 10⅔ seconds, the greatest length of sheet the machine could fold at the first quarter point is 10⅔ ft. For a distance *a* equalling 6 ft. the corresponding maximum length would be ⅔ times said 6 ft., that is, 8 ft. This applies for a rotating speed of the gear 73 of three quarters of the full speed. Where the speed of the gear 73 has another ratio to the speed of the full speed gear 75, such as one half, the distance *a* is to be multiplied by the reciprocal of that ratio to obtain the maximum sheet length. Thus, for a distance *a* of 8 ft. a sheet up to 16 ft. could be folded, whereas for folding a sheet of 10 ft. length a distance *a* of 5 ft. would be sufficient.

Where the distances *a* and *b* shown in Fig. 1 are different, this difference can be taken care of by adjusting the position of the starting point of the rotation of either the arm 94 or the arm 95. To perform such an adjustment the clamp-bolt 99 is loosened and the bracket 100 carrying the spring member 97 turned the appropriate amount around the respective spindle 49 or 50 so that the bolt 99 slides in the slot 102. The clamp-bolt 99 is then retightened in the desired position of the bracket 100. It will be seen from Fig. 7 that from the position of the parts shown in that figure an adjustment may be made in the clockwise as well as in the anticlockwise direction.

While there is shown in Figs. 1 to 9 of the drawings one particular embodiment of the invention and in Fig. 1*a* a modification of one detail thereof, there is desired for it to be understood that this embodiment has been given by way of example only and that various changes and modifications in the details of the construction may be made without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In a timer, a spindle displaceable between three different axial positions, two end positions and a position intermediate said two end positions, means for holding said spindle in said intermediate axial position in a predetermined angular position of rest, two coupling members carried by said spindle, a driver having a counter coupling member facing one of said coupling members, a second driver having a counter coupling member facing the other of said two coupling members and operating at a speed different from that of the first named driver, means for shifting said spindle from its intermediate axial position into its one end position to bring the one of said two coupling members into engagement with said first named driver, means for terminating the engagement of the coupling member just mentioned with the counter coupling member on said first named driver after less than a full revolution of said spindle to allow the spindle to move from its one axial end position past said intermediate position to the second axial end position wherein the other coupling member is in engagement with the counter coupling member on said second driver, means for restoring the spindle to said intermediate axial position upon said spindle completing a full revolution from said predetermined angular position of rest, actuating means carried by said spindle and apparatus operating means placed at a fixed angular position in the path along which said actuating means revolve when said spindle is in said second axial end position.

2. In a timer, a vertical spindle displaceable between three different positions of height, two end positions and a position intermediate said two end positions, means for supporting said spindle in said intermediate position of height in a predetermined angular position of rest, an upper and a lower coupling member carried by said spindle, an upper driver having a counter coupling member facing said upper coupling member, a lower driver having a counter coupling member facing said lower coupling member and operating at a speed different from that of the upper driver, means for lifting said spindle from said intermediate position of height into its up-

per end position to bring said upper coupling member into engagement with the counter coupling member on said upper driver, means for terminating the engagement of said upper coupling member with the counter coupling member on said upper driver after less than a full revolution of said spindle to allow the spindle to drop from its upper end position past the intermediate position to its lower end position wherein said lower coupling member is in engagement with the counter coupling member on said lower driver, means for restoring the spindle to said intermediate position of height upon said spindle completing a full revolution from said angular position of rest, actuating means carried by said spindle and apparatus operating means placed at a fixed angular position in the path along which said actuating means revolve when said spindle is in its lower end position.

3. In a timer, a vertical spindle displaceable between three different positions of height, two end positions and a position intermediate said two end positions, means for supporting said spindle in said intermediate position of height in a predetermined angular position, means for rotating said spindle at one rate when in its upper end position and at another rate when in its lower end position, electromagnetic means for elevating said spindle from said intermediate position to its upper end position and holding it there, means for terminating the holding action of said elevating and holding means so as to allow said spindle to drop into its lower end position by gravity, and resilient means for mechanically elevating said spindle from said lower end position to said intermediate position upon said spindle having performed a full revolution from said predetermined angular position.

4. In a timer, a vertical spindle displaceable between three different positions of height, two end positions and a position intermediate said two end positions, means for supporting said spindle in said intermediate position of height in a predetermined angular position of rest, an upper and a lower coupling member carried by said spindle, an upper driver having a counter coupling member facing said upper coupling member, a lower driver having a counter coupling member facing said lower coupling member and operating at a speed different from that of the upper driver, electromagnetic means for lifting said spindle from said intermediate position of height into its upper end position to bring said upper coupling member into engagement with the counter coupling member on said upper driver, means for terminating the engagement of said upper coupling member with the counter coupling member on said upper driver after less than a full revolution of said spindle to allow the spindle to drop from its upper end position past the intermediate position to its lower end position wherein said lower coupling member is in engagement with the counter coupling member on said lower driver, and resilient means for mechanically restoring the spindle to said intermediate position of height upon said spindle completing a full revolution from said angular position of rest.

5. A timer for timing the incidence of a locating or folding device upon a sheet carried on a conveyer past said locating or folding device comprising, in combination, a coupling element rotatable about a vertical axis, means for driving said coupling element at a speed proportional to the speed of said conveyer, another coupling element rotatable about the same axis placed above the first named coupling element, means for moving the second named coupling element at a speed bearing a fixed ratio to that of the first coupling element, a vertical spindle in the axis of said two coupling elements, means operable by said vertical spindle when in a particular angular position for actuating said locating or folding device, coupling means carried by said spindle adapted to engage either of the previously named coupling elements to change the angular position of the spindle, means for normally supporting the spindle at a neutral position of height at which said coupling means carried by the spindle are out of engagement with both said coupling elements, a measuring element, means actuatable by the passage of said sheet past said measuring element and adapted to elevate said spindle into engagement with the upper of said coupling elements, means for terminating the engagement of said spindle with the upper coupling element when said sheet leaves said measuring element so as to allow said spindle to fall into engagement with the lower coupling element, and means for lifting the spindle into said neutral position of height upon said spindle having carried out one full revolution from its starting position.

6. A timer for timing the incidence of a locating or folding device upon a sheet carried on a conveyer past said locating or folding device comprising, in combination, a coupling element rotatable about a vertical axis, means for driving said coupling element at a speed proportional to the speed of said conveyer, another coupling element rotatable about the same axis placed above the first named coupling element, means for moving the second named coupling element at a speed bearing a fixed ratio to that of the first coupling element, a vertical spindle in the axis of said two coupling elements, means operable by said vertical spindle when in a particular angular position for actuating said locating or folding device, coupling means carried by said spindle adapted to engage either of the previously named coupling elements to change the angular position of the spindle, means for normally supporting the spindle in a neutral position of height at which said coupling means carried by the spindle are out of engagement with both said coupling elements, a measuring element, electromagnetic means actuatable by the passage of said sheet past said measuring element and adapted to elevate said spindle into engagement with the upper of said coupling elements, switch means for terminating the action of said electromagnetic means upon said spindle when said sheet leaves said measuring element so as to allow said spindle to fall into engagement with the lower coupling element, and resilient means for mechanically lifting the spindle into said neutral position of height upon said spindle having carried out one full revolution from its starting position.

7. A timer for timing the incidence of a locating or folding device upon a sheet carried on a conveyer past said locating or folding device comprising, in combination, a measuring element, a plurality of identical timing units, each timing unit including a coupling element rotatable about a vertical axis, means for driving said coupling element at a speed proportional to the speed of said conveyer, another coupling element rotatable about the same axis placed above the first named coupling element, means for moving

the second named coupling element at a speed bearing a fixed ratio to that of the first coupling element, a vertical spindle in the axis of said two coupling elements, means operable by said vertical spindle when in a particular angular position for actuating said locating or folding device, coupling means carried by said spindle adapted to engage either of the previously named coupling elements to change the angular position of the spindle, means for normally supporting the spindle in a neutral position of height at which said coupling means carried by the spindle are out of engagement with both said coupling elements, electromagnetic means operable by the passage of said sheet past said measuring element and adapted to elevate said spindle into engagement with the upper of said coupling elements and a switch in the circuit of said electromagnetic means, the plurality of switches coordinated respectively to the plurality of timing units being controlled by a sequence relay for closing a different switch and thereby preconditioning for action a different timing unit each time the rear end of a sheet leaves said measuring element so that each time a sheet arrives at said measuring element another one of said electromagnetic means is actuated and the spindle coordinated to that electromagnetic means is elevated into engagement with its coordinated upper coupling element, and a switch controlling said electromagnetic means for releasing the spindle which had been elevated for falling into engagement with its coordinated lower coupling element when the sheet which actuated said electromagnetic means leaves said measuring element.

8. A timer for timing the incidence of a locating or folding device upon a sheet carried on a conveyer past said locating or folding device comprising, in combination, a measuring element, a plurality of identical timing units, each timing unit including a coupling element rotatable about a vertical axis, means for driving said coupling element at a speed proportional to the speed of said conveyer, another coupling element rotatable about the same axis placed above the first named coupling element, means for moving the second named coupling element at a speed bearing a fixed ratio to that of the first coupling element, a vertical spindle in the axis of said two coupling elements, means operable by said vertical spindle when in a particular angular position for actuating said locating or folding device, coupling means carried by said spindle adapted to engage either of the previously named coupling elements to change the angular position of the spindle, means for normally supporting the spindle in a neutral position of height at which said coupling means carried by the spindle are out of engagement with both said coupling elements, electromagnetic means operable by the passage of said sheet past said measuring element and adapted to elevate said spindle into engagement with the upper of said coupling elements and a switch in the circuit of said electromagnetic means, the plurality of switches coordinated respectively to the plurality of timing units being controlled by a sequence relay for closing a different switch and thereby preconditioning for action a different timing unit each time the rear end of a sheet leaves said measuring element so that each time a sheet arrives at such measuring element another one of said electromagnetic means is actuated and the spindle coordinated to that electromagnetic means is elevated into engagement with its coordinated upper coupling element, a switch controlling said electromagnetic means for releasing the spindle which had been elevated for falling into engagement with its coordinated lower coupling element when the sheet which actuated said electromagnetic means leaves said measuring element, and resilient means for mechanically lifting said spindle into said neutral position of height upon said spindle having carried out one full revolution from its starting position.

9. A timer for sheet folding machines adapted to fold the sheets more than once, comprising in combination, a number of spindles corresponding to the number of folds to be made, a solenoid common to all said spindles for lifting, when energized, all said spindles simultaneously into an upper end position and to allow all said spindles to drop simultaneously into a lower end position when said solenoid is de-energized, a double-faced gear coupling member secured to each spindle, two counter gear coupling members coordinated to each gear coupling member and situated above and below said coupling member so that said gear coupling member positively engages the teeth of the upper of said counter gear coupling members when in its lifted end position and the teeth of the lower gear counter coupling member when in its lower end position while being completely out of engagement with either counter coupling member when in a position midway said two end positions, and means for driving said counter coupling members coordinated to each spindle at different rates bearing a pre-set ratio to one another, all the lower counter coupling members being driven at the same rate whereas each of the upper counter coupling members is driven at a different fraction of the rate at which the lower counter coupling members are driven.

10. In a timer for sheet folding machines having at least one folding device, a vertical spindle displaceable between three different positions of height, two end positions and a position intermediate said two end positions, means for supporting said spindle in said intermediate position of height in a predetermined angular position of rest, an upper and a lower coupling member carried by said spindle, an upper driver having a counter coupling member facing said upper coupling member, a lower driver having a counter coupling member facing said lower coupling member and operating at a speed different from that of the upper driver, means for lifting said spindle from said intermediate position of height into its upper end position to bring said upper coupling member into engagement with the counter coupling member on said upper driver, means for terminating the engagement of said upper coupling member with the counter coupling member on said upper driver after less than a full revolution of said spindle to allow the spindle to drop from its upper end position past the intermediate position to its lower end position wherein said lower coupling member is in engagement with the counter coupling member on said lower driver, an arm secured to said spindle adapted to cooperate, when said spindle rotates in its lower end position, with means for actuating a folding device at a predetermined point of the rotation of said arm so that upon said arm encountering said actuating means the folding device is actuated, and a guide element in the path of said arm for moving said spindle from its lower end position to its intermediate position of height.

11. In a timer for sheet folding machines having at least one folding device, a vertical spindle displaced between three different positions of height, two end positions and a position intermediate said two end positions, means for supporting said spindle in said intermediate position of height in a predetermined angular position of rest, an upper and a lower coupling member carried by said spindle, an upper driver having a counter coupling member facing said upper coupling member, a lower driver having a counter coupling member facing said lower coupling member and operating at a speed different from that of the upper driver, means for lifting said spindle from said intermediate position of height into its upper end position to bring said upper coupling member into engagement with the counter coupling member on said upper driver, means for terminating the engagement of said upper coupling member with the counter coupling member on said upper driver after less than a full revolution of said spindle to allow the spindle to drop from its upper end position past the intermediate position to its lower end position wherein said lower coupling member is in engagement with the counter coupling member on said lower driver, an arm secured to said spindle adapted to cooperate, when said spindle rotates in its lower end position, with means for actuating a folding device at a predetermined point of the rotation of said arm so that upon said arm encountering said actuating means the folding device is actuated, and a guide element in the path of said arm for moving said spindle from its lower end position to its intermediate position of height, said guide element being shaped so as to provide a cradle for said arm when the spindle assumes said intermediate position.

12. A timer for timing a plurality of locating or folding operations upon a sheet carried on a conveyor, comprising in combination a measuring element, a plurality of sets of identical timing units, each such set having as many timing units as there are locating or folding operations to be performed per sheet and each timing unit including a spindle displaceable between three different axial positions, two end positions and a position intermediate said two end positions, means for holding each spindle in said intermediate axial position in a predetermined angular position of rest, each set of timing units having common electromagnetic means for shifting the spindles belonging to that set of timing units simultaneously from their intermediate axial position to their one end position, a switch for each set of timing units in the circuit of each of said electromagnetic means, the plurality of switches being controlled by a sequence relay for closing a different switch and thereby preconditioning for action a different set of timing units each time the rear end of a sheet leaves said measuring element so that another one of said electromagnetic means is actuated and the plurality of spindles coordinated to that electromagnetic means is shifted from said intermediate position to said one end position each time a sheet arrives at said measuring element.

13. A timer for sheet folding machines adapted to make more than one fold on each sheet, comprising in combination, a plurality of spindles and a plurality of folding device actuating means both corresponding in number to the number of folds to be made per sheet, means for moving said spindles into one of three different axial positions, two end positions and a middle position, a coupling member secured to each spindle, two counter coupling members coordinated to each coupling member, said coupling member positively engaging one of said counter coupling members when in its one end position and the other counter coupling member when in its other end position while being completely out of engagement with either counter coupling member when in its middle position, and means for driving said counter coupling members coordinated to each spindle at different rates bearing a preset ratio to one another, said ratio being different for each spindle, as many rock shafts as folds are to be made per sheet, each rock shaft cooperating with means for closing a circuit controlling one of the folding device actuating means when said rock shaft is rocked, at least one abutment on each said rock shaft, and an arm secured to each spindle for causing rocking of the coordinated rock shaft when said arm encounters an abutment on said rock shaft.

14. A timer for sheet folding machines adapted to fold the sheets more than once, comprising in combination, a plurality of spindles and a plurality of folding device actuating means, both corresponding in number to the number of folds to be made per sheet, means for moving said spindles axially into one of three different positions, two end positions and a middle position, a coupling member secured to each spindle, two counter coupling members coordinated to each coupling member, said coupling member positively engaging one of said counter coupling members when in its one end position and the other counter coupling member when in its other end position while being completely out of engagement with either counter coupling member when in its middle position, means for driving said counter coupling members coordinated to each spindle at different rates bearing a pre-set ratio to one another, said ratio being different for each spindle, as many rock shafts as there are folds to be made per sheet, each rock shaft cooperating with means for closing a circuit controlling one of said folding device actuating means when said rock shaft is rocked, an abutment on each rock shaft, an arm secured to each spindle for causing rocking of the coordinated rock shaft when said arm encounters said abutment on said rock shaft while the coordinated spindle rotates in its lower end position, and a guide element in the path of each of said arms for moving the coordinated spindle into its middle position, said guide element being shaped so as to provide a cradle for said arm when the spindle assumes said middle position.

15. A timer for sheet folding machines adapted to fold sheets more than once, comprising in combination, a measuring element, a plurality of sets of identical timing units, each such set having as many timing units as there are folds to be made per sheet, each timing unit including a spindle displaceable between three different axial positions, two end positions and a position intermediate said two end positions, means for holding each spindle in said intermediate axial position in a predetermined angular position of rest, each set of timing units having electromagnetic means for shifting all the spindles belonging to that set simultaneously from their intermediate axial position to their one end position, a switch for each set of timing units in the circuit of each of said electromagnetic means, the plurality of switches being controlled by a sequence

relay for closing a different switch and thereby preconditioning for action a different set of timing units each time the rear end of a sheet leaves said measuring element so that another one of said electromagnetic means is actuated and the plurality of spindles coordinated to that electromagnetic means is shifted from said intermediate position to said one end position each time a sheet arrives at said measuring element, as many rock shafts and as many folding device actuating means as there are sets of timing units, each rock shaft cooperating with means for closing a circuit controlling one of the folding device actuating means when said rock shaft is rocked, abutments on each said rock shaft, and an arm secured to each spindle for causing rocking of the coordinated rock shaft when said arm encounters an abutment on said rock shaft while the coordinated spindle rotates in its second end position.

16. A timer for sheet folding machines adapted to fold sheets more than once, comprising in combination, a measuring element, a plurality of sets of identical timing units, each such set having as many timing units as there are folds to be made per sheet, each timing unit including a spindle displaceable between three different axial positions, two end positions and a position intermediate said two end positions, means for holding each spindle in said intermediate aixal position in a predetermined angular position of rest, each set of timing units having electromagnetic means for shifting the spindles belonging to that set of timing units simultaneously from their intermediate axial position to their one end position upon a sheet arriving at said measuring element, a switch for each set of timing units in the circuit of each of said electromagnetic means operative to de-energize said electromagnetic means upon the rear end of the sheet which caused the energization of said electromagnetic means leaving said measuring element so as to allow the spindle of the coordinated set of timing units to assume their other axial end position, the plurality of switches being controlled by a sequence relay for closing a different switch and thereby preconditioning for action a different set of timing units each time the rear end of a sheet leaves said measuring element so that another one of said electromagnetic means is actuated and the plurality of spindles coordinated to that electromagnetic means is shifted from said intermediate position to said one end position each time a sheet arrives at said measuring element, as many rock shafts and as many folding device actuating means as there are sets of timing units, each rock shaft cooperating with means for closing a circuit controlling one of the folding device actuating means when said rock shaft is rocked, abutments on each said rock shaft, and an arm secured to each spindle for causing rocking of the coordinated rock shaft when said arm encounters an abutment on said rock shaft while the coordinated spindle rotates in its second end position, and a guide element in the part of each of said arms for moving the coordinated spindle into its intermediate position.

17. A timer for sheet folding machines adapted to fold sheets more than once, comprising in combination, a measuring element, a plurality of sets of identical timing units, each such set having as many timing units as there are folds to be made per sheet, each timing unit including a vertical spindle displaceable between three different positions of height, two end positions and

a position intermediate said two end positions, means for supporting each spindle in said intermediate position of height in a predetermined angular position of rest, each set of timing units having electromagnetic means for lifting the spindles belonging to that set of timing units simultaneously from their intermediate position to their upper end position upon a sheet arriving at said measuring element, a switch for each set of timing units in the circuit of each of said electromagnetic means operative to de-energize said electromagnetic means upon the rear end of the sheet which caused the energization of said electromagnetic means leaving said measuring element, so as to allow the spindle of the coordinated set of timing units to drop into their lower end position, the plurality of switches being controlled by a sequence relay for closing a different switch and thereby preconditioning for action a different set of timing units each time the rear end of a sheet leaves said measuring element so that another one of said electromagnetic means is actuated and the plurality of spindles coordinated to that electromagnetic means is lifted from said intermediate position to said one end position each time a sheet arrives at said measuring element, as many rock shafts and as many folding device actuating means as there are sets of timing units, each rock shaft cooperating with means for closing a circuit controlling one of the folding device actuating means when said rock shaft is rocked, an abutment on each said rock shaft, and an arm secured to each spindle for causing rocking of the coordinated rock shaft when said arm encounters said abutment on said rock shaft while the coordinated spindle rotates in its lower end position, and a guide element in the path of each of said arms for moving the coordinated spindle into its intermediate position, said guide element being shaped so as to provide a cradle for said arm when the spindle assumes said intermediate position.

18. In a folding device for sheets, in combination, a number of measuring devices each adapted to measure the length of a passing sheet, a solenoid for each measuring device to put it into action, a normally elevated measuring finger depressed while a sheet is passing, means for passing the sheet over the measuring finger, a normally open switch closed by the depression of the finger, circuits from said switch to each of said solenoids, a switch in each of said circuits, a selector device to close one of said last named switches and open all the rest, a solenoid operated stepper to move the selector device, a normally closed switch opened by the depression of the finger to release said selector solenoid so that upon the passage of the end of the sheet the stepper solenoid will again be energized to put another measuring device in position to measure the next sheet to pass over the finger.

19. In a device which correlates the actuation of a mechanism with the spacing and size of the pieces fed to the mechanism, a spindle assembly axially displaceable between a first-end and an intermediate position and a second-end position, a finger projecting from said spindle, means for holding said spindle in its intermediate axial position with the finger in a predetermined angular position, means to move the spindle assembly to the first-end position on the arrival of the front end of one of said pieces at a given point, a continuously rotating driving element engaged by the spindle assembly when the spindle is thus moved to its first-end position to turn the spindle

at one rate, means to move the spindle assembly to the second-end position on the arrival of the rear end of said piece at the same given point, a second driving element continuously rotating at another speed engaged by the spindle assembly when it is thus moved to its second-end position, a device controlling the actuation of said mechanism engaged by said finger after the finger has travelled through a preset arc.

20. In a device which correlates the actuation of a mechanism with the spacing and size of the pieces fed to the mechanism, a spindle assembly axially displaceable between a first-end and an intermediate position and a second-end position, a finger projecting from said spindle, means for holding said spindle in its intermediate axial position with the finger in a predetermined angular position, means to move the spindle assembly to the first-end position on the arrival of the front end of one of said pieces at a given point, a continuously rotating driving element engaged by the spindle assembly when the spindle is thus moved to its first-end position to turn the spindle at one rate, means to move the spindle assembly to the second-end position on the arrival of the rear end of said piece at the same given point, a second driving element continuously rotating at another speed engaged by the spindle assembly when it is thus moved to its second-end position, a device controlling the actuation of said mechanism engaged by said finger after the finger has travelled through a preset arc, and a resetting device engaged by the finger after it has passed the actuating device which resets the spindle assembly in its intermediate position of rest with the finger in its original predetermined angular position.

21. In a device which correlates the actuation of a mechanism with the spacing and size of the pieces fed to the mechanism, a vertical spindle assembly axially displaceable between an upper and an intermediate position and a lower position, a finger projecting from said spindle, means for holding said spindle in its intermediate axial position with the finger in a predetermined angular position, means to elevate the spindle assembly to its upper position during the passage of one of said pieces past a given point, a continuously rotating driving element engaged by the spindle assembly when the spindle is thus held in its elevated position to turn the spindle at one rate, a second driving element continuously rotating at another speed engaged by the spindle assembly when it is allowed to fall from its upper to its lower position after said piece has passed the given point, a device controlling the actuation of said mechanism engaged by said finger after the finger has travelled through a preset arc.

22. In a device which correlates the actuation of a mechanism with the spacing and size of the pieces fed to the mechanism, a vertical spindle assembly axially displaceable between an upper and an intermediate position and a lower position, a finger projecting from said spindle, means for holding said spindle in its intermediate axial position with the finger in predetermined angular position, means to elevate the spindle assembly to its upper position during the passage of one of said pieces past a given point, a continuously rotating driving element engaged by the spindle assembly when the spindle is thus held in its elevated position to turn the spindle at one rate, a second driving element continuously rotating at another speed engaged by the spindle assembly when it is allowed to fall from its upper to its lower position after said piece has passed the given point, a device controlling the actuation of said mechanism engaged by said finger after the finger has travelled through a preset arc, and a resetting device engaged by the finger after it has passed the actuating device which elevates the spindle assembly to its intermediate position of rest with the finger in its original predetermined angular position.

23. In a device which correlates the actuation of a mechanism with the spacing and size of the pieces fed to the mechanism, a vertical spindle axially displaceable between an upper and an intermediate and a lower position, an upper and a lower coupling member carried by said spindle, a finger projecting from the lower part of said spindle, means for holding said spindle in its intermediate axial position with the finger in a predetermined angular position, means adapted to elevate the spindle to its upper position during the passage of one of said pieces past a given point, a continuously rotating driving element having a coupling member engaged by the upper coupling member on the spindle when the spindle is thus held in its elevated position to turn the spindle at one rate, a second driving element having a coupling member continuously rotating at another speed which is engaged by the lower coupling member on the spindle when the spindle is allowed to fall from its upper to its lower position after said piece has passed a given point, a device controlling the actuation of said mechanism engaged by said finger after a rotation of the spindle has carried the finger through a preset arc, and a resetting device engaged by the finger after it has passed the actuating device and completed one full revolution to elevate the spindle to its intermediate position of rest with the finger in its original predetermined angular position.

24. A timer for making several successive folds in a sheet passing through a folding machine, comprising in combination, a plurality of spindles, means for simultaneously shifting said spindles axially from their intermediate positions to an end position, a plurality of driving members each running at a different speed and each spindle in its end position engaging one of said driving members, means for simultaneously shifting all of said spindles axially to a second end position, a second group of driving members each operating at a different speed and each one of said driving elements being engaged by one of said spindles when it moves into its second end position, a finger carried by each of said spindles and originally oriented in a fixed angular position when the spindle is in its intermediate position, a plurality of devices each of which is adapted to actuate one of said folding means when the finger in whose path the particular device is placed has passed through a preset angle, and means for moving each spindle back to its intermediate position with the finger oriented upon completion of one revolution by that spindle.

25. A timer for making several successive folds in a sheet passing through a folding machine, comprising in combination, a plurality of vertical spindles, means for simultaneously elevating said spindles axially from their intermediate positions to their upper positions, a plurality of driving members each running at a different speed and each spindle in its elevated position engaging one of said driving members, means for simultaneously letting all of said spindles drop to their lower positions, a second group of driving mem-

bers each operating at different speeds and each one of said driving elements being engaged by one of said spindles when it is dropped to its lower position, a finger carried by each of said spindles and originally oriented in a fixed angular position when the spindle is in its intermediate position, a plurality of devices each of which is adapted to actuate one of said folding means when the finger in whose path the particular device is placed has passed through a preset angle, and means for elevating each spindle to its intermediate position with the finger oriented upon completion of one revolution of that spindle.

26. A controller for a folding machine of the type adapted to fold articles of unknown length following in close succession into predetermined fractional folds; comprising a plurality of timing mechanisms each having a movable member operable at a speed corresponding to full speed of the folder and another member movable at a fractional speed, means for actuating one of said timing mechanisms at said fractional speed during passage of an article to be folded past a predetermined point and at said full speed thereafter whereby said article and its fractional portion for folding are measured by said timing mechanism, means cooperable with any one of said timing mechanisms for actuating the folder when articles to be folded are in proper position, and a selector mechanism mounted to be unrestricted in its operation by the movement of said movable members for determining which of said timing mechanisms shall be actuated on passage of a particular article to be folded.

27. In apparatus of the type in which operating means performs an operation, proportionate to article length, upon each of a series of articles fed in succession along a path at a selected speed, improved controlling means for said operating means, comprising a plurality of article measuring units, each having a movable member operable at a speed proportional to the selected speed and another member movable at a speed that is a fractional speed of the selected speed, said members being operatively associated with said operating means to control and cause actuation thereof, a single trip device cooperating therewith and so located as to be sensitive to travel of an article along said path, movable selector means mounted to be unrestricted in operation by the movement of said movable members, said selector means being controlled by said trip device and operatively connected to said measuring units and adapted by its movement and in cooperation with said trip device to first cause one of said measuring units to operate at said fractional speed to measure an article and then to cause said one of said measuring units to operate at the selected speed and effect actuation of said operating means, and a controller also sensitive to travel of an article along said path for determining which of said units becomes operative upon operating movement of said selector means in response to the next following article.

28. In apparatus of the type in which operating means performs an operation, proportionate to article length, upon each of a series of articles fed in succession along a path at a selected speed, improved controlling means for said operating means, comprising a plurality of article measuring units, each having a movable member operable at a speed proportional to the selected speed and another member movable at a fractional speed of the selected speed, said member being operatively associated with said operating means

to control and cause actuation thereof, a single trip device cooperating therewith and so located as to be sensitive to travel of an article along said path, and movable selector means mounted to be unrestricted in operation by the movement of said movable members, said selector means being controlled by said trip device and operatively connected to said measuring units and adapted by its movement in cooperation with said trip device to first cause one of said measuring units to operate at said fractional speed to measure an article and then to cause said one of said measuring units to operate at the proportional speed and effect actuation of said operating means to perform an operation, each of said units including means for causing separate actuations of said operating means at different points spaced apart upon the article.

29. In apparatus of the type in which operating means performs an operation, proportionate to article length, upon each of a series of articles fed in succession along a path, improved controlling means for said operating means, comprising a plurality of article measuring units, each having at least two relatively axially movable rotatable members adapted by their axial movement to be engaged for rotating one of the members by the other to measure at least a portion of an article, said driven member when rotated being operatively associated with said operating means to control and cause actuation thereof, a single trip device cooperating therewith and so located as to be sensitive to travel of an article along said path, movable selector means controlled by said trip device and operatively connected to said measuring units and adapted by its movement in cooperation with said trip device to first cause one of said measuring units to measure an article and cause actuation of said operating means, and a controller also sensitive to travel of an article along said path for determining which of said units becomes operative upon operating movement of said selector means in response to the next following article.

30. In apparatus of the type in which operating means performs an operation, proportionate to article length, upon each of a series of articles fed in succession along a path, improved controlling means for said operating means, comprising a plurality of article measuring units, each having at least two relatively axially movable rotatable members adapted by their axial movement to be engaged for rotating one of members by the other to measure at least a portion of an article, said driven member when rotated being operatively associated with said operating means to control and cause actuation thereof, a single trip device cooperating therewith and so located as to be sensitive to travel of an article along said path, and movable selector means controlled by said trip device and operatively connected to said measuring units and adapted by its movement in cooperation with said trip device to first cause one of said measuring units to measure an article and cause actuation of said operating means to perform an operation, each of said units including means for causing separate actuations of said operating means at different points spaced apart upon the article.

31. A controller for a folder operable at a selected speed of the type adapted to fold articles of unknown length following in close succession into predetermined fractional folds; comprising a plurality of timing mechanisms each having a

movable member operable at a speed corresponding to the selected speed of the folder and another member movable at a speed corresponding to a fractional speed, means within said timing mechanism driven alternately by said movable members first at the fractional speed during passage of an article to be folded past a predetermined point and at the selected speed thereafter whereby said article and its fractional portion for folding are measured by said timing mechanism, means for actuating the folder when the article to be folded is in proper position, a selector mechanism mounted to be unrestricted in its operation by the movement of said movable members for determining which of said timing mechanisms shall be actuated on passage of a particular article to be folded, and article responsive means for stepping said selector mechanism to accomplish sequential operation of the timing mechanisms.

32. A controller for a folding machine movable at a selected speed of the type adapted to fold articles of unknown length following in close succession into predetermined fractional folds and including a folding device for performing a folding operation upon an article; comprising a plurality of timing mechanisms each operable at a proportional speed of the selected speed of the folding machine at one time and at another time at a fractional speed of the proportional speed, means for actuating one of said timing mechanisms at the fractional speed during passage of an article to be folded past a predetermined point whereby said article and its fractional portion for folding are measured by said timing mechanism, means cooperable with said timing mechanism when moving at the proportional speed for actuating said folding device when the article to be folded is in proper position, a selector mechanism mounted to be unrestricted in its operation by the movement of said timing mechanisms for determining which of said timing mechanisms shall be actuated on passage of a particular article to be folded, and article responsive means for stepping said selector mechanism to accomplish sequential operation of the timing mechanisms.

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Heirs of the estate of Benjamin S. Kagan, deceased.

No references cited.