

Dec. 10, 1935.

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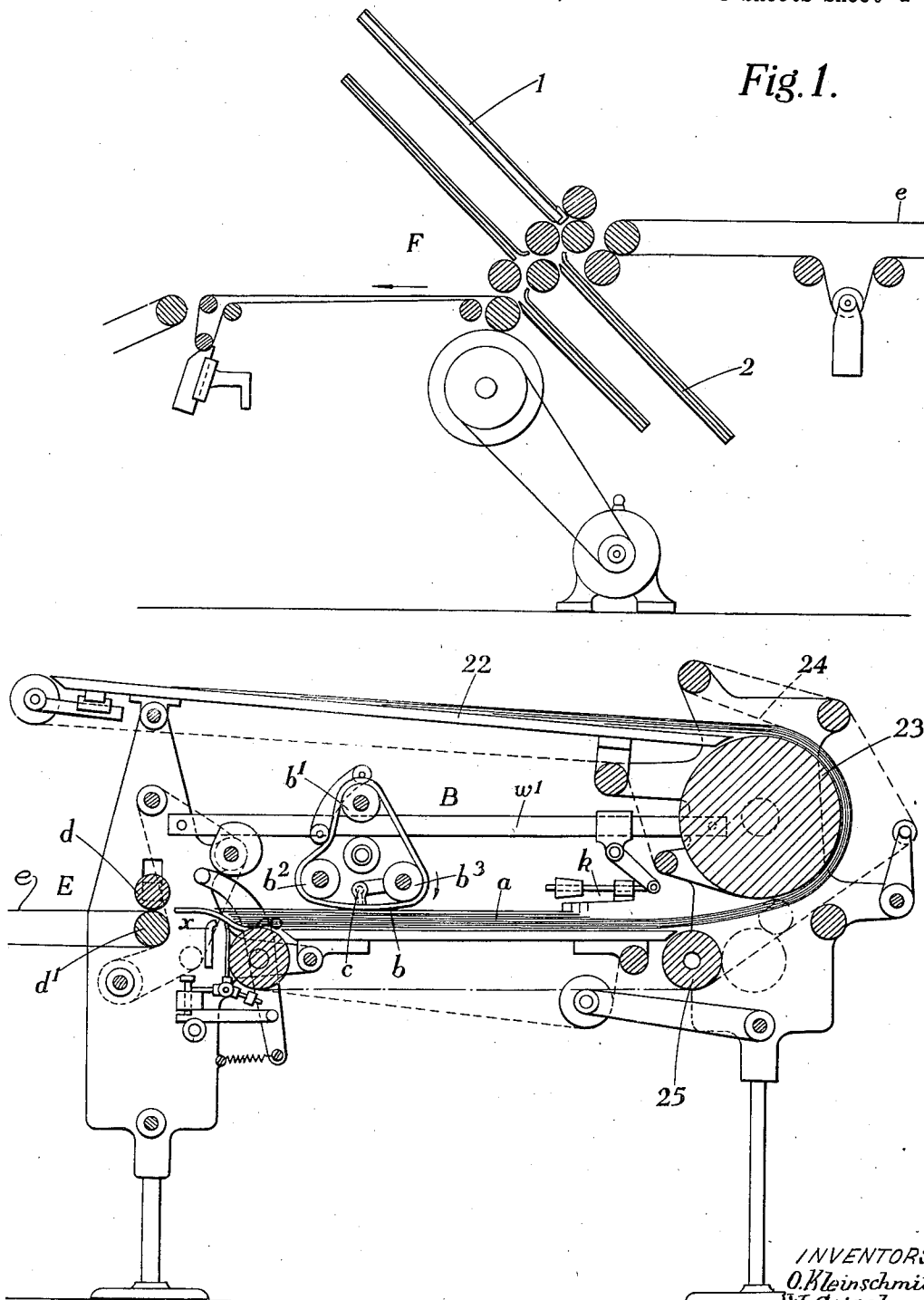
2,023,531

APPARATUS FOR FEEDING SHEETS TO FOLDING MACHINES

Filed March 25, 1935

5 Sheets-Sheet 1

Fig. 1.



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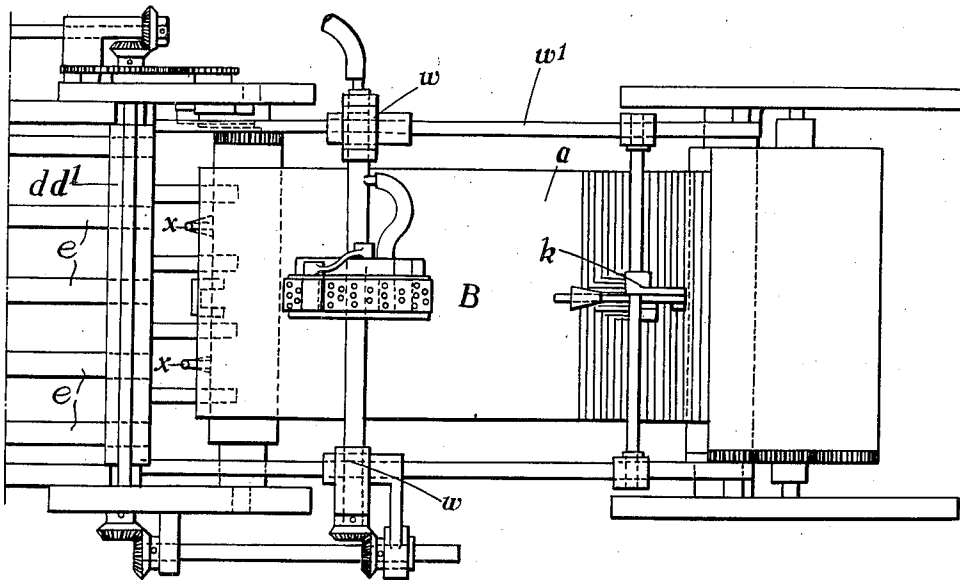
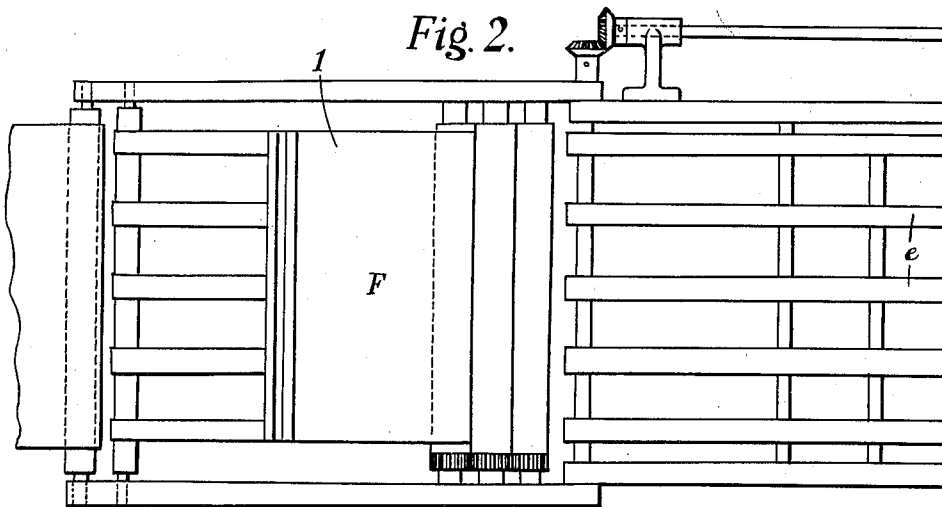
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5 Sheets-Sheet 2



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5 Sheets-Sheet 3

Fig. 3.

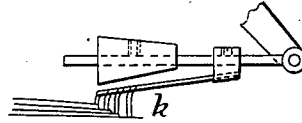
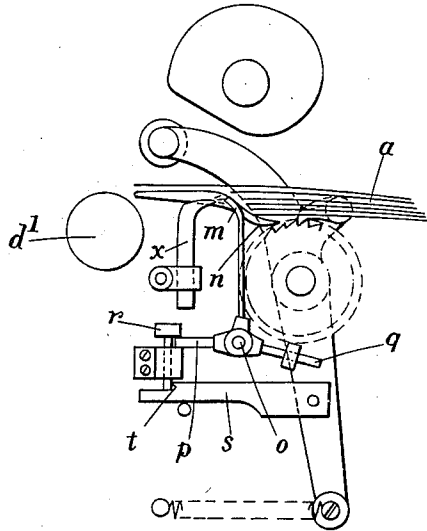


Fig. 5.

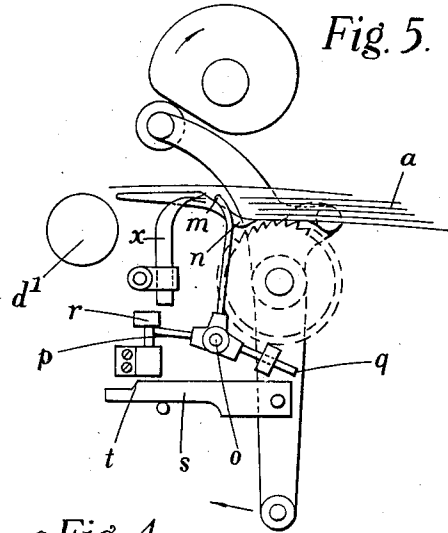
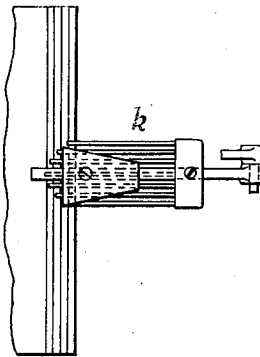
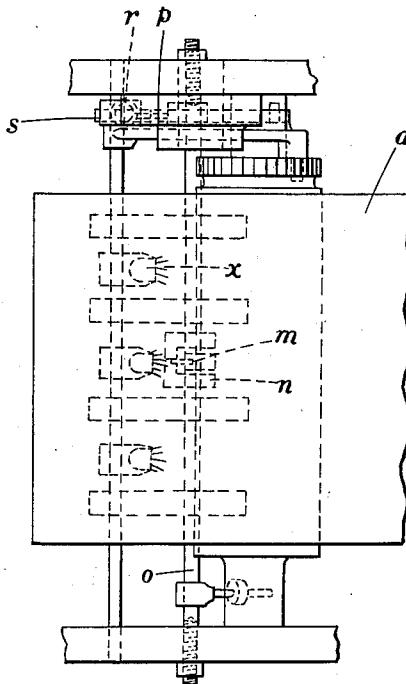


Fig. 4.



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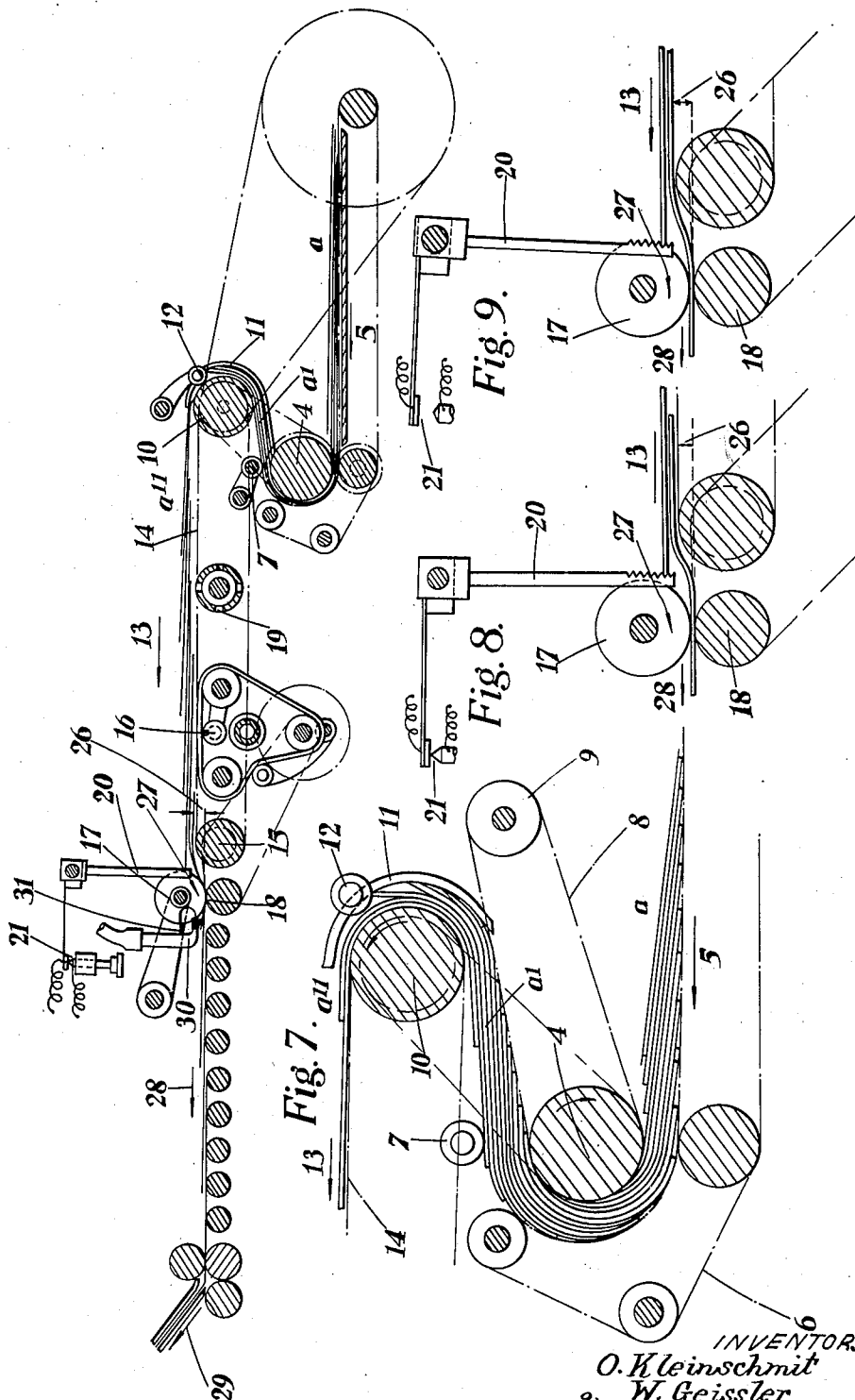
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5 Sheets-Sheet 4

Fig. 6.



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Filed March 25, 1935

5 Sheets-Sheet 5

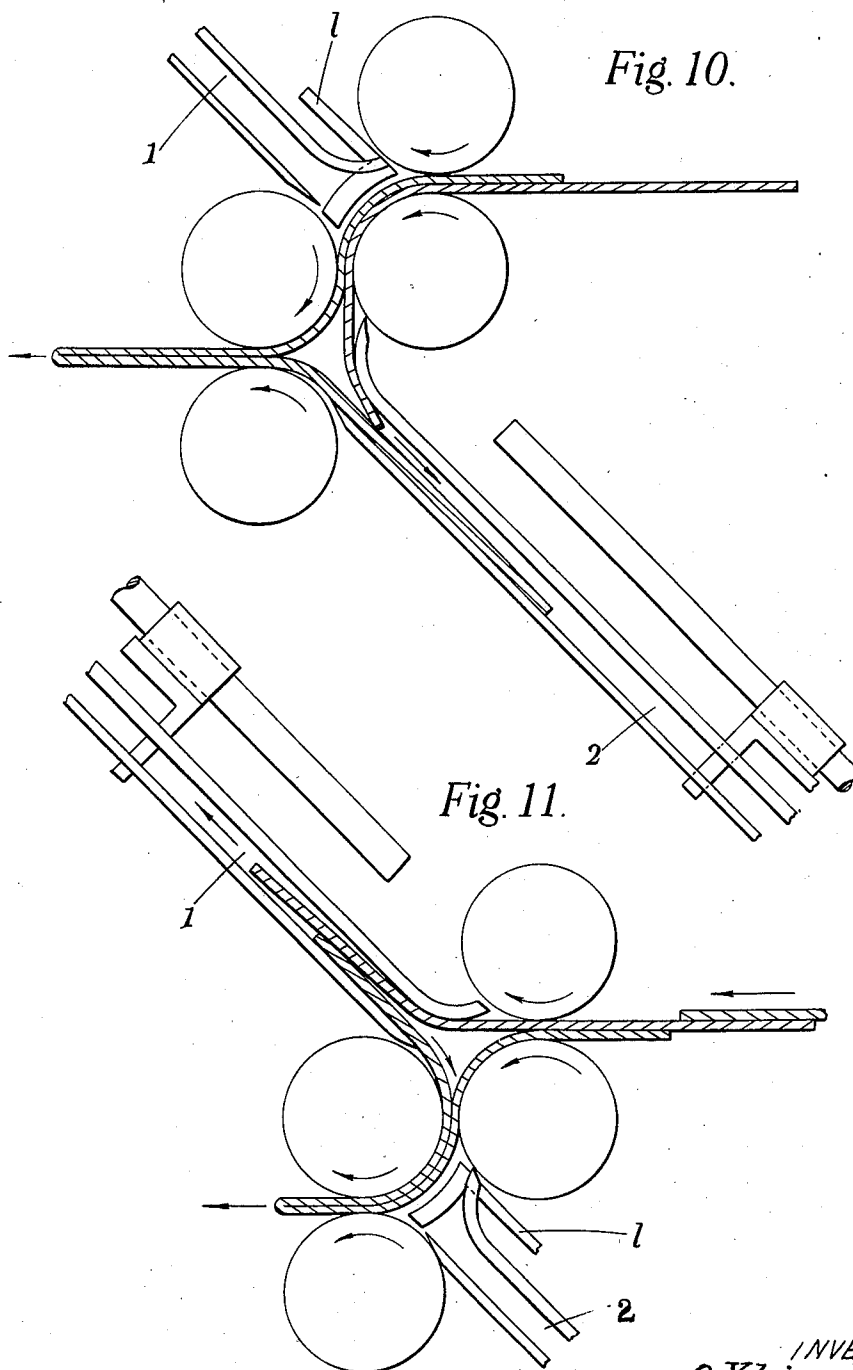


Fig. 11.

Fig. 10.

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2,023,531

APPARATUS FOR FEEDING SHEETS TO
FOLDING MACHINES

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Application March 25, 1935, Serial No. 12,944
In Germany December 23, 1933

6 Claims. (Cl. 271—33)

The present invention relates to mechanism for feeding individual sheets from a stack successively to a sheet folding device comprising a folding pocket, from either the top or the bottom of the stack, so as to form an endless succession of sheets.

The main object of the invention is to reduce the distance travelled by the sheets between the original stack and the folding mechanism, the invention providing a mechanism which ensures that the sheets are automatically fed forward one upon the other with a uniform overlap which can be adjusted at will.

The method of feeding sheets individually from a stack to a folding device, comprising a buckle folding pocket, according to this invention, consists in feeding the sheets from a fanned-out stack in a continuous stream by the co-operation of two separate relatively adjustable feeding devices simultaneously employed for separating and conveying said sheets from the stack in succession with an overlap which is automatically determined and maintained in accordance with a predetermined distance between the two said feeding devices. The first feeding device may consist of a pair of co-operating feed rollers transferring the sheets to a tape or like conveyor and the second feeding device, of a suction feeder. If it is desired to feed the sheets so that the half of one sheet overlaps the half of the next sheet the distance between the two feeding devices is made approximately equal to half the length of the sheets.

The first feeding device adjacent to the forward edge of the sheet stack, feeds the overlapping sheets forward to the folding mechanism, and the second co-operating suction feeder device which is applied to the medial portion of the sheet stack takes hold of the middle of the uppermost (or lowermost) sheet of the stack and advances it until its leading edge is taken up by the first feeding device.

At the moment when the first sheet has been fed halfway past the suction feeder, i. e. is only half covering the next sheet of the stack, the rear edge of the first sheet becomes free of the suction feeder which then acts upon the next sheet, which in turn becomes fed forward at the same speed as the first sheet. Since they are both fed forward at the same speed they will remain overlapped to an extent depending upon the distance between the two feeding devices.

It is immaterial to the invention whether the sheets are fed to the folding mechanism from the top or the bottom of the stack.

When however the sheets are fed from the bottom of the stack the first device feeding the folding mechanism is located at a level below that of the advancing sheet so that its leading edge is deflected or bent downwardly. Within this sheet deflecting portion of the sheet track detecting mechanism is arranged that is automatically controlled by the leading edge of the advancing sheet for the automatic control of the intermittent feed from the stack.

The prearranged stack is fed into the machine by a conveyor belt driven by a shaft also driving at a higher speed a feed roller associated with a curved guide plate providing a curved path for fanning the leading edges of the sheets and co-operating with a presser roller, bearing on the surface of the first roller through an aperture in the guide plate to grip and successively pull forward the leading sheets.

The invention is illustrated by way of example in the accompanying drawings showing, by way of example only, two constructions of machines according thereto: In these drawings:—

Figure 1 is a longitudinal sectional diagram in two parts of one construction of a machine according to the invention with certain parts removed for the sake of clearness in which the sheets are removed from the lower end of the stack.

Figure 2 is a diagrammatic plan view in two parts of the machine shown in Figure 1.

Figures 3 and 4 are detail diagrams showing respectively in side elevation and plan view, the sheet feeding control mechanism, and the braking device of Figures 1 and 2.

Figure 5 is a view of the sheet feeding control mechanism shown in Figures 3 and 4, with the parts in position to cause sheet feeding to take place.

Figure 6 is a longitudinal and diagrammatic sectional view of an alternative construction of machine, in which the sheets are removed from the bottom of the stack.

Figure 7 is an enlarged view of the first mechanism for fanning out the sheets, in the machine of Figure 6.

Figures 8 and 9 are detail views illustrating the detector mechanism within a sheet deflecting portion of the feed track of Figure 6, Figure 8 showing the parts in normal position and Figure 9 with the detector operating to cause stoppage of the sheet feed.

Figures 10 and 11 are views illustrating the methods of folding the overlapped sheets.

In both arrangements, whether the sheets are

fed from the top of the stack as shown in the first construction (Figures 1 and 2) or from the bottom of the stack (Figures 6 and 7) the sheets are fed to the folding mechanism overlapped to the extent determined by the distance between the adjustable feeding devices, and their arrival at the folding pockets must be so timed that the front end of one sheet commences to enter the first folding pocket when the preceding sheet has buckled and commenced to travel in the reverse direction, out of the pocket. Consequently, in the case of Figures 1 and 2 the sheets must pass into the lower pocket 2 and the upper pocket 1 must be closed by a device such as the shutter *l*, as shown in Figure 10, whilst in the case of Figures 6 and 7 folding must take place in the upper pocket 1, and the lower pocket 2 must be closed, as shown in Figure 11.

In Figures 1 and 2 of the drawings the suction feeding device is indicated generally by the reference B, the first feeding device by E, and the folding machine by F.

Referring now to Figures 1 and 2, *a* is the stack of sheets upon a supporting table for feeding to the folding mechanism at F. Above the stack is disposed the suction feeding device B, which comprises a suction band *b* passing round rollers *b*¹, *b*², *b*³. A vacuum is maintained in the suction box *c* which is disposed within the band *b*, and this draws the uppermost sheet into contact with the band so that it is carried along at the same speed as the band until it is taken up by the first feeding device E. This comprises rollers *d*, *d*¹ which transfer the sheets on to the travelling tapes *e* by which they are carried to the rollers of the folding mechanism F.

The distance between roller *b*³ and roller *d* is approximately half the width of a sheet if the sheets are to overlap to that extent. On the rear portion of the sheet stack rests the braking device *k*, which in this case is in the form of a gravity shoe or claw having a plurality of separate hooks loosely mounted and arranged in arrow head formation (Figures 2, 3 and 4). This brake is adjustable to suit the size of the sheets and is so disposed that only the foremost hooks are still in contact with the rear portion of the uppermost sheet when its leading edge reaches the rollers *d* *d*¹. The underlying sheet is therefore held back by the frictional drag of a considerable number of claw hooks. Other kinds of brake devices, for example, a moving or stationary suction tube or roller may be employed.

The suction feeding device B is mounted on supports *w* which may be locked in position after adjustment along the guide rods *w*¹ in the longitudinal direction of the sheets to give different extents of overlap, its suction and driving mechanism being such as to permit this, and the feeding rollers *d* *d*¹ may be also relatively adjustable. Provision may also be made for vertical adjustment of the suction feeding device B. Such adjustment may be effected automatically, but as a rule will not be required since the suction should be sufficient to make the topmost sheet jump towards the suction band. A single suction feeding device B may be employed disposed centrally of the sheet as shewn or several of them may be employed distributed transverse-ly of the sheet surface.

At the forward end of the table supporting the sheet stack *a* is disposed a curved guide plate or ramp *n* Figures 3, 4 and 5, which guides the uppermost sheet between the feed rollers *d* *d*¹. For controlling the feed of the sheets a feeler finger *m*

bears through a slot in the plate *n* on the edge of the sheet stack (see Figures 3 and 4). Normally this finger *m* is pushed back by the edge of the sheet stack to lie flush with the surface of plate *n*, offering no impediment to the removal of the top sheet. If, however, there is no second sheet in engagement with the finger *m*, the latter can swing forward and thus set the feeding mechanism into operation.

To this end the finger *m* is mounted on a spindle carrying two levers *p* and *q* and a gravity slide *r* normally holds the lever *p* in the lower position, owing to the provision of a counter weight on lever *q*.

Beneath the slide *r* is disposed a locking member *s* which rests on a supporting pin and is connected with and movable with a pawl lever which is spring held at its lower end and is oscillated at its upper end by a rotating cam. This pawl is adapted to operate a ratchet wheel, rotation of which supplies additional sheets to underneath stack *a* as hereinafter described. When the finger *m* is in its backward position, i. e. a sufficient number of sheets is in contact with the guide plate *n*, the parts are in the positions shown in Figure 3, with the slide *r* lowered into engagement with the step *t* of locking member *s*. The pawl lever is thus locked in the forward position in which its driving cam is ineffective. Consequently the paper feed to stack *a* is interrupted. However, on there being insufficient sheets in stack *a* the finger *m* moves forward, thereby raising slide *r* and releasing locking member *s*, whereby the pawl lever comes into operation to feed the paper forward into the stack *a* through its ratchet wheel (Figure 5). When a sufficient number of sheets is again in the stack *a* the finger *m* is pushed back, the slide *r* drops and the paper feed becomes suspended again.

The sheets are supplied to the stack *a* from an inclined table 22 mounted above the stack *a* and discharging to a fixed roller 23 to the surface of which it is held by the endless conveyor 24. The roller 23 rotates under the influence of the conveyor belt 24 which is intermittently driven through roller 25, by the pawl and ratchet gear controlled by finger *m* as already explained.

The machine so far described operates as follows:—

After adjustment of the suction feeder B, say to half the sheet length from *d*, and with the sheet stack *a* full, the machine is started up and the uppermost sheet will be sucked up and carried along the transfer band *b* until its leading edge is engaged between rollers *d* *d*¹ which move at the same speed as the linear speed of band *b*.

At this moment it becomes free of the brake *k* which then acts to hold back the underlying sheets while the top sheet is pulled off by the rollers *d* *d*¹. When the rear edge of the top sheet arrives at *b*³ it is half overlapping the underlying sheet and immediately afterwards, as soon as any suction openings of the band are uncovered by the top sheet, the underlying sheet is sucked up by the feeder B and carried along at the same speed as the topmost sheet. The overlap is thus maintained and the same operation is repeated with successive sheets.

In order completely to eliminate the drag caused by adhesion of the sheets the machine preferably includes air blast nozzles *x* operative through apertures in the guide plate *n* to inject a stream of compressed air beneath the topmost sheet and the underlying sheet, so that the top sheet is floated off on a layer of air, thereby re-

ducing the friction between sheets to a minimum and avoiding any tendency to premature feeding of the second sheet even with greatly increased working speed.

5 Turning now to the alternative arrangements shewn in Figures 6 to 9, as shewn in Figure 6 and more clearly in Figure 7 in this case the stacks *a* are placed by hand upon a conveyor belt running over the surface of the table at the right
10 hand end of Figure 6 after slight pre-arrangement by hand so that the leading edges of the sheets presented to the lower feed roller 4 are set back from bottom to top, whereby the sheets
15 are drawn off in the direction of arrows 5 and pass round roller 4 with the lowermost sheet leading, the sheets being held to roller 4 by an idle conveyor belt 6. The sheets are held down on roller 4 by a presser roller 7 and on reaching
20 position *a'* the sheets are supported by a conveyor belt 8, Figure 7, (not shown in Figure 6) passing round roller 4 and another roller 9 in a slightly higher position. After reaching position
25 *a'* the sheets pass into a space between the upper feed roller 10 and a guide plate 11, and owing to the bending of the sheets in passing round roller 10 their leading edges spread out under the control of the guide plate 11.

The sheet immediately next to the roller 10 and originally at the bottom of the pile *a* will be the leading sheet, and this will contact with the presser roller 12 which bears on the surface of the roller 10 through an aperture in plate 11. This roller is faced with rubber, so that the leading sheet will be gripped between rollers 10 and
35 12.

The roller 10 is driven through belt or chain gearing from the shaft which drives the conveyor belt 6 but at a much greater peripheral speed than the linear speed of the conveyor belt at *a* and *a'* and the peripheral speed of roller 4. Consequently the sheet gripped between the rollers 10 and 12 will be accelerated and since it will only be frictionally loaded by the other sheets, it will be easily pulled out from the other sheets.
40

As each succeeding sheet fanned out against guide plate 11 comes between rollers 10 and 12 the same action will take place, so that the echeloning of the sheets will be increased by the time they have passed roller 10 and reached position *a''*. In other words the stepping of the sheets will be increased and the whole sheet stack, as it were, loosened, to an extent depending upon the relative speeds of 4 and 10.
45

At position *a''* the sheets pass in the direction of arrow 13 on to a roller table or on the surface of another conveyor belt 14 passing round roller 10 and another roller 15 located between the suction feeder device 16 and the feed device 17, 18.
50

The suction feeder comprises an exhaustor 16 travelling at the same speed as the surfaces of the rollers 17, 18 and intermediate between this device and the roller 10 is the suction-roller 19 which has the same surface speed as the conveyor at *a''* and operates on the lowermost sheet also by suction. The distance between the exhaustor 16 and the rollers 17, 18 is adjusted to half the length of the sheets which are to be dealt with if the sheets are to overlap to that extent and the brake device 19 is also set at half
55 a sheet length from the exhaustor 16.

Should the feed be so rapid that the lowermost leading sheet approaching the device 17, 18 strikes the detector 20, the latter is swung about its pivot and in doing so breaks an electric contact at 21, or operates by some other known
60

means to stop the driving mechanism of the sheets at *a*, *a'* and *a''*, so that the progress of the sheets is thus arrested.

At the same time, however, the preceding sheet seized by the exhaustor 16 and fed to 17, 5 18 has reached such a position that its rear edge has left the exhaustor 16, which then grips the next sheet which had struck the detector 20 and thus arrested the progress of the sheets at *a*, *a'* and *a''*. As the sheet is moved forward by exhaustor 16 its leading edge is deflected or bent
10 downwardly to the extent of the step 26 in the direction of the arrow 27 and enters between rollers 17 and 18. The detector 20 is thus released to swing forward again and make contact 15 at 21, which renders operative the conveyor mechanism at *a*, *a'* and *a''*, and causes resumption of the feed, so long as the next sheet has not advanced sufficiently to prevent the detector 20 from resuming its normal position (Figures 20 8 and 9).

The sheets are fed by the rollers 17, 18 in the direction of the arrow 28, at the required speed for folding, in a double stream of superposed sheets overlapping to such an extent that when 25 the leading sheet starts to buckle after entering the upper folding pocket in the direction of the arrow 29, and its loop formation commences, the front edge of the next sheet will commence entering the folding pocket. Consequently, instead of 30 the sheets when folded being discharged in a stream having gaps equal to the width of the folded sheets, they will be discharged in a continuous stream having no gaps i. e. the output will be double that of machines in which the 35 sheets are fed to the folding mechanism end to end instead of in overlapping relation.

The horizontal distance between the rollers 4 and 10 need only be small, since the object is merely to fan out and separate the leading edges 40 of the sheets, whilst the roller 4 is only provided additionally to the roller 10 in order to absorb the sheet stack and leave the feed table free to receive another pile of sheets at *a*.

The distance from 10 to 17, 18 need only be so 45 great as to correspond with the largest sheet likely to have to be dealt with, but the brake device 19 must be so disposed that with the largest size of sheet, the roller 10 and the brake 19 do not interfere with one another in their action. 50 The operation of the exhaustor 16 and the brake 19, which may be spaced at any convenient distance, may be effected in any convenient manner, and does not form part of the invention.

An important factor for the smooth working of 55 the machine lies in the provision between the delivery rollers 17, 18 and the folding mechanism, of a blowing device, which is known per se, and which, owing to the deflection of the leading edge of the sheet in striking the detector 20, is 60 enabled to direct a current of air along the upper surface of the sheet, and thus relieve the lowermost sheet engaged in the rollers 17, 18 from the weight of the few sheets lying upon it, thereby almost entirely eliminating frictional drag on the 65 lowermost sheet. This blowing device comprises one or more pipes 30 provided with discharge nozzles directed in the required manner and a curved guard 31 is provided to prevent the front edge of the sheets from striking the nozzles. 70

The presser foot roller 7 is of any desired shape and adaptable to suit the size of the sheets to be dealt with in such manner as to hold fast the rear edge of a sheet whilst the preceding 75

sheet is being pulled forward by the rollers 10 and 12.

The means for conveying the sheets from the device 17, 18 to the folding mechanism may be of any desired kind, the drawings illustrating a well known arrangement of inclined rollers which straighten out the sheets. Such straightening may, however, be effected in any other suitable and convenient manner.

From the foregoing it will be appreciated that in operation the loading table at *a* is supplied with small stacks of fanned-out sheets the steps of which are increased by the rollers 10 and 11, after which the overlap of the sheets is still further reduced to the required amount of half the sheet width by the adjustable feeding devices 16 and 17, 18 before being fed to the folding mechanism in a continuous stream of sheets half overlapping one another.

It will be understood that in using this invention in connection with a folding mechanism of the pocket type working on the buckling principle, each sheet will commence to enter a folding pocket just as the previous sheet has buckled and commences to withdraw from the pocket, so that the time occupied by a sheet in withdrawing from a pocket is usefully occupied by the next sheet in entering the pocket.

As will be appreciated from the foregoing description the invention enables a folding machine to be supplied with a constantly traveling stream of sheets which are automatically overlapped to the desired extent, having regard to the folding to be effected, whilst the regularity of the stream ensures great reliability of working, and owing to its simplicity the mechanism is easy to operate and cheap to manufacture. Moreover, the highly important advantage is obtained of greatly increased output notwithstanding the relatively slow rate of feed.

What we claim is:—

1. Method of feeding sheets individually from a stack of sheets to a folding device comprising a buckle folding pocket which consists in feeding the sheets from a fanned-out stack in a continuous stream from a point in the position of the sheet chosen to give a desired overlap when fed to another fixed point from which the sheets are fed without change of speed for separating and conveying said sheets from the stack in succession with an overlap which is automatically determined and maintained in accordance with

the position of the first feeding point on the sheet.

2. Means for feeding sheets into a folding device, comprising a pair of feed rollers transferring the sheets to a tape or like feed conveyor combined with a suction feeder bearing substantially midway on the foremost sheet of a fanned out sheet stack, said feed rollers and suction feeder being driven to run at the same speed in synchronism with the folding speed and arranged at a distance between them which is adjustable in accordance with the required overlap of the individual sheets they feed in succession from the stack.

3. The method of automatically feeding sheets in accordance with claim 1 into the folding pocket of a buckle folding device characterized by the introduction in a continuous stream of consecutive sheets from a sheet stack into said pocket in such manner that as one sheet is about to move out of said pocket after receiving a fold the next sheet has already entered the pocket, substantially as described.

4. Means for feeding sheets into a folding device as claimed in claim 2 in which the suction feeder device acting on the medial portion of the sheet stack is adjustable along the machine, to which end it is carried by a movable mounting which may be locked in adjusted position, substantially as described.

5. In means for feeding sheets into a folding device, as claimed in claim 2, the provision between the two co-operating sheet feeding devices of detecting mechanism automatically controlled by the forward edge of the advancing foremost sheet within a sheet deflecting portion of the feed track for the automatic control of the intermittent stack feed substantially as described.

6. Means for feeding sheets into a folding device, as claimed in claim 2, from the bottom of a prearranged stack fed into the machine by a conveyor belt driven by a shaft also driving at a higher speed a feed roller associated with a curved guide plate providing a curved path for fanning the leading edges of the sheets and co-operating with a presser roller, bearing on the surface of the first roller through an aperture in the guide plate, to grip and successively pull forward the leading sheets, substantially as described.

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