Sept. 17, 1940. G. L. PIERCE 2,214,752

SHEET FEEDING MECHANISM

Filed June 14, 1939 4 Sheets-Sheet 1

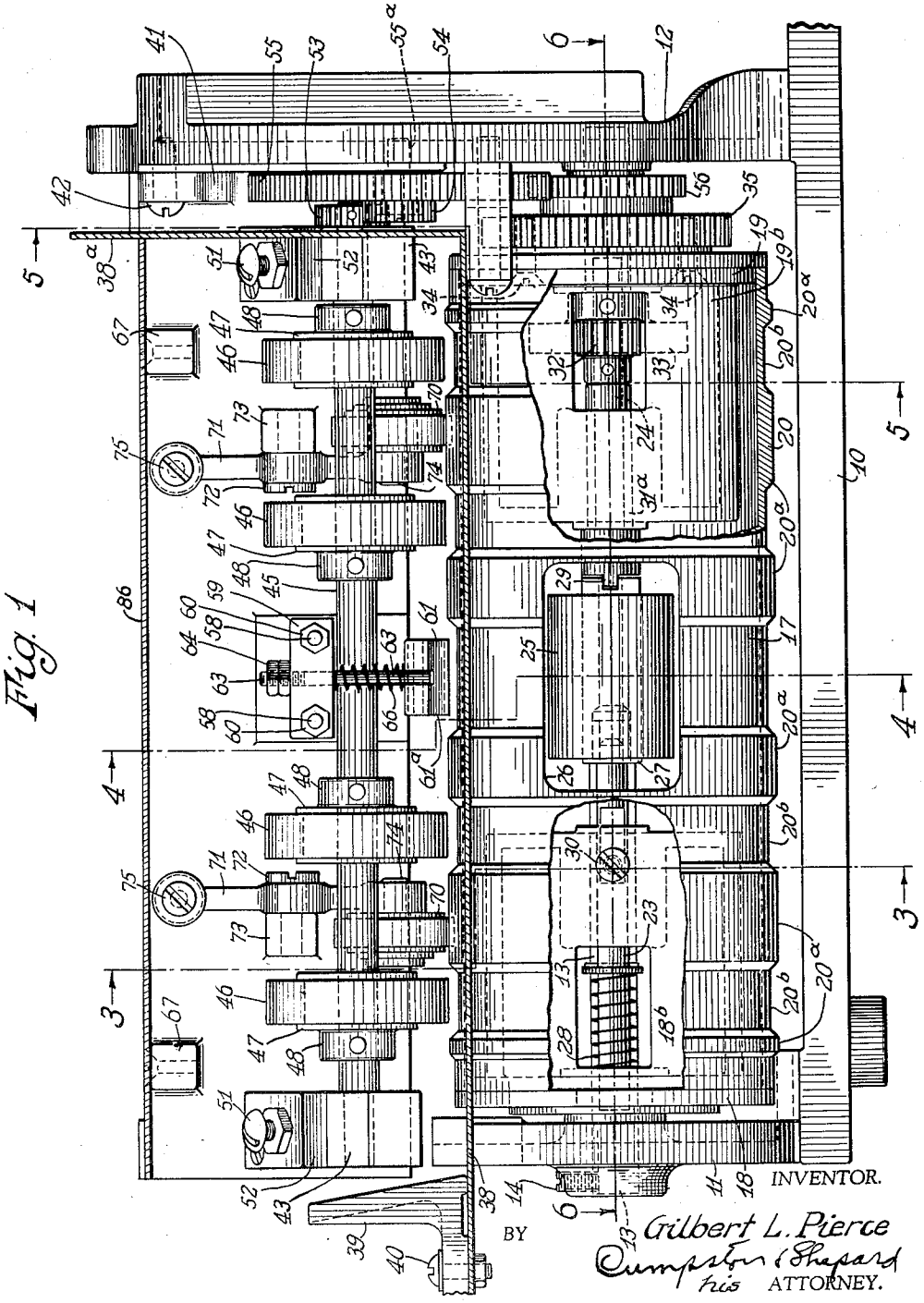

Fig. 1

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SHEET FEEDING MECHANISM

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Fig. 2

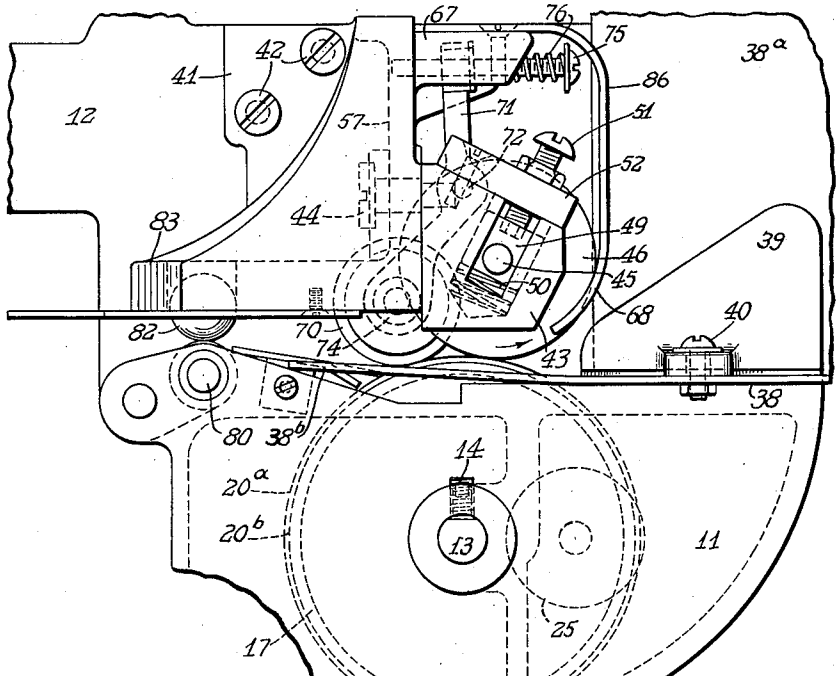
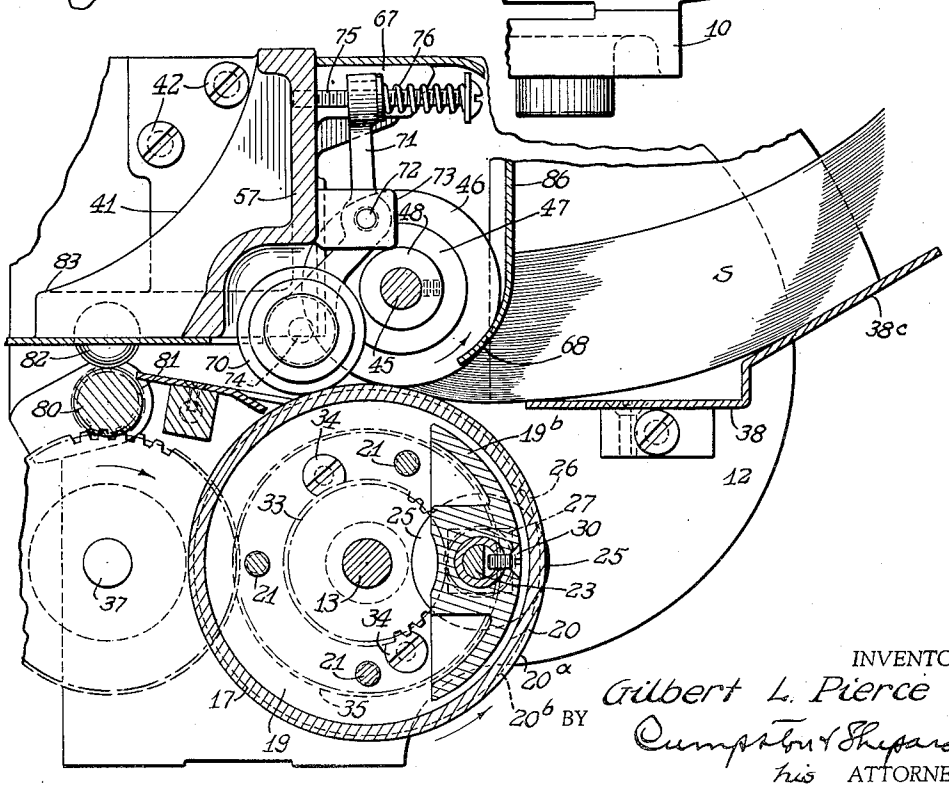


Fig. 3



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SHEET FEEDING MECHANISM

Filed June 14, 1939 4 Sheets-Sheet 3

Fig. 4

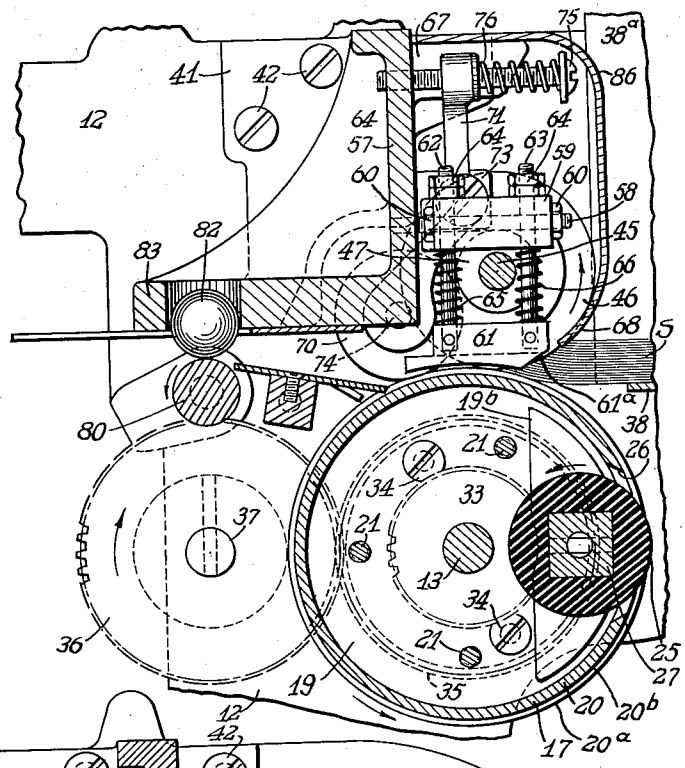
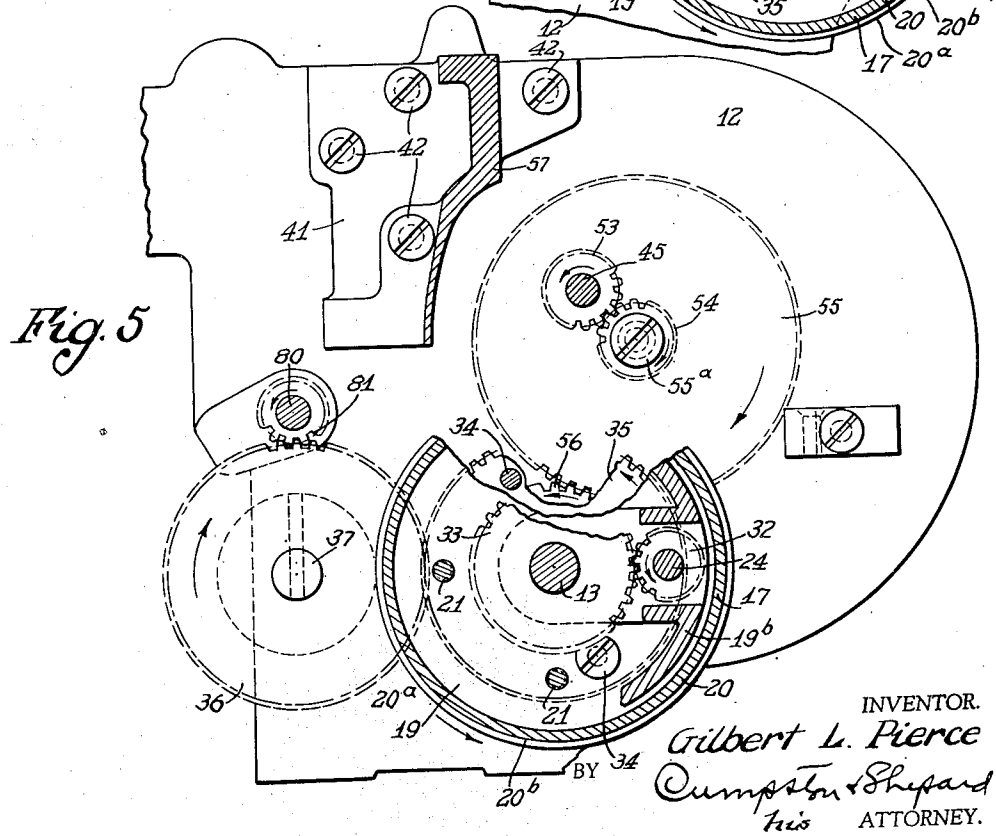


Fig. 5



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SHEET FEEDING MECHANISM

Filed June 14, 1939 4 Sheets-Sheet 4

Fig. 7

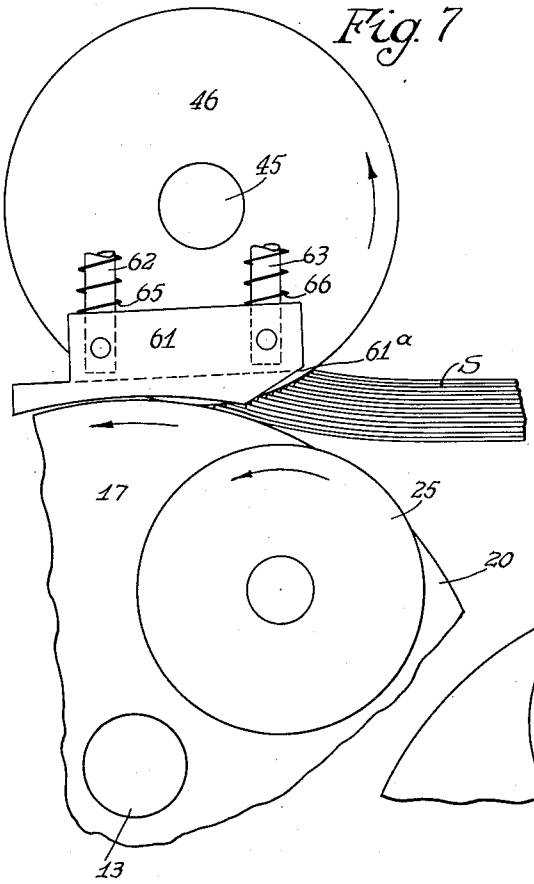

Fig. 8

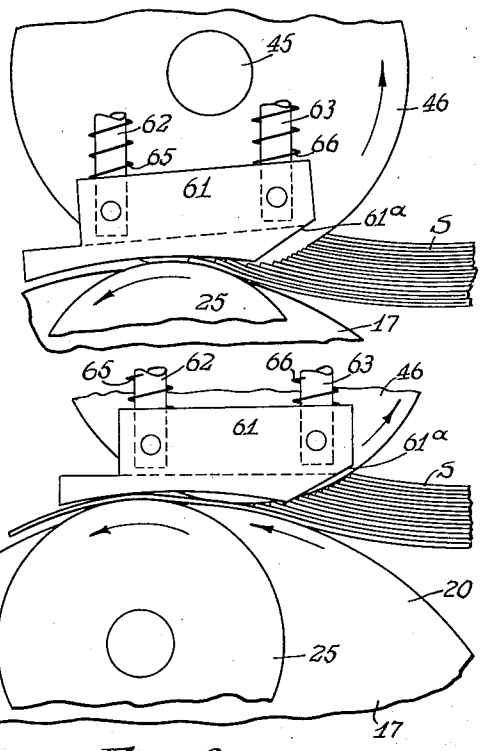

Fig. 9

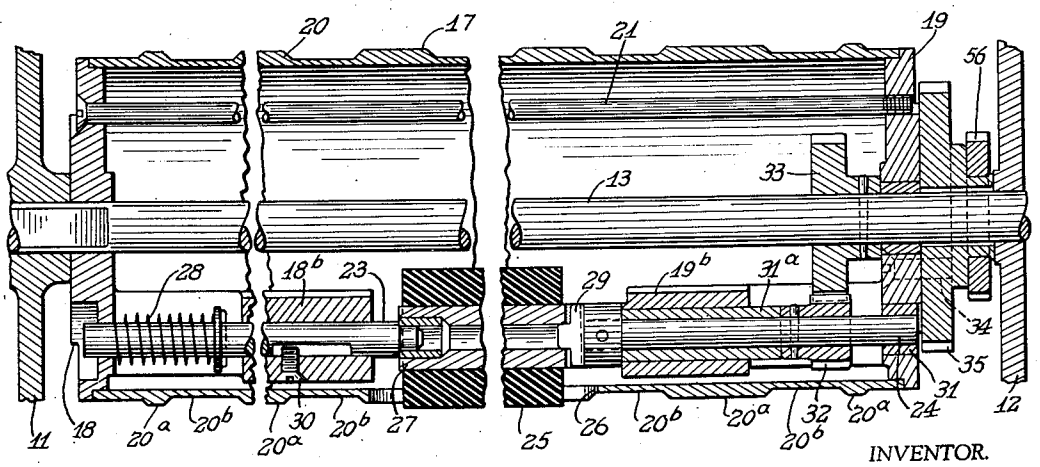

Fig. 6

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UNITED STATES PATENT OFFICE

2,214,752

SHEET FEEDING MECHANISM

Gilbert L. Pierce, Rochester, N. Y., assignor to The Todd Company, Inc., Rochester, N. Y., a corporation of New York

Application June 14, 1939, Serial No. 279,141

38 Claims. (Cl. 271—41)

The present invention relates in general to an improved mechanism for feeding sheets of paper or other articles from a supply stack and advancing the sheets successively through the mechanism, or feeding them to an associated machine or device, and is a continuation-in-part of my copending applications, Serial Nos. 169,479 and 207,340, filed October 16, 1937 and May 11, 1938, respectively.

One object of the invention is to provide an automatic and efficient sheet feeding mechanism adapted to operate reliably at a high rate of speed, without requiring the services of a skilled operator or an undue amount of attention.

Another object is the provision of a mechanism of the above character capable of feeding sheets rapidly and uniformly, one at a time, and adapted for coordination with other mechanism for further handling of such sheets.

A further object is the provision of such a mechanism having a simple, compact and convenient construction and arrangement of parts, with the parts accessibly disposed for convenient adjustment in use, and for removal for cleaning, repair, or replacement.

To these and other ends the invention resides in certain improvements and combinations of parts, all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings:

Fig. 1 is a front elevational view of a sheet feeding mechanism formed in accordance with the present invention;

Fig. 2 is a side elevation as viewed from the left side of the mechanism shown in Fig. 1;

Fig. 3 is a vertical sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a detailed vertical sectional view taken substantially on the line 4—4 of Fig. 1;

Fig. 5 is a vertical sectional view taken substantially on the line 5—5 of Fig. 1, showing the driving mechanism for the parts of the feed mechanism;

Fig. 6 is a detailed horizontal sectional view taken through the cylindrical feed means or drum on the plane indicated by the line 6—6 of Fig. 1;

Fig. 7 is an enlarged diagrammatic view showing parts of the feed mechanism in the position assumed prior to the engagement of the friction roller with the bottom sheet of the stack on the supporting means;

Fig. 8 is a similar view wherein the friction roll has initially displaced a sheet from the stack;

Fig. 9 also is a similar view showing parts of the feed mechanism in their advanced position wherein the bottom sheet has been partially displaced from the stack and is being advanced through the feeding mechanism.

The same reference numerals throughout the several views indicate the same parts.

The invention comprehends an automatic feeding mechanism which is unfailing in its operation of picking or displacing a single sheet of paper or other material from a stack, and of separating and moving a sheet rapidly through the feeding mechanism. The mechanism exerts a pronounced sudden gripping effect or jerking action on the bottom sheet of a stack at the pick-up station and at the same time will move the sheet from under the other sheets without causing them to follow. Other improvements included in the invention are means for positioning and retaining the sheets at the pick-up station, and for effecting continued advancement of a sheet through the feeding device after it has been initially started in its movement from the stack.

The sheet feeding mechanism forming the subject matter of the present invention is adapted for any use wherein it is desired to move a sheet at a time from a supply stack. The mechanism is particularly adapted to operate in combination with machines for performing other operations on or in connection with sheets of paper or similar articles, such as, printing, perforating, cutting or folding devices. However, it is to be understood that the feeding mechanism forming the present invention is adaptable to operate as a separate unit or in combination with a device to automatically and successively feed sheets of paper or other material.

Referring now to the drawings, the reference numeral 10 generally designates a base which may be in the nature of a separate casting to support the feeding mechanism or may be formed as a part of a machine to which the sheets are fed. At one side of the base there is mounted a supporting frame 11, and on the other side thereof a supporting frame 12, best shown in Figs. 1, 2, and 5. Registering openings are formed in the frames 11 and 12 for the stationary shaft 13. A set screw 14 provided in a boss formed on the frame 11 engages the flattened end of shaft 13 to secure it against rotation in the supports.

Journaled for rotation about the axis provided by shaft 13 is a feed means in this instance in the form of a cylinder device or drum 17, comprising end sections 18 and 19 arranged at the end of a tubular body 20, Figs. 1 and 6. The end

sections are formed with registering openings for the reception of tie-bolts 21 provided to secure the end members with the body 20. Each end member has its inner portion reduced to fit within the ends of the tubular body 20, and formed with the projecting bosses 18b and 19b. The inwardly extending bosses on end members 18 and 19 are formed with openings arranged in registration with similar openings formed in the end walls 18 and 19. The openings in the end walls and bosses at each end of the feed drum are in registration to receive axially aligned members comprising the plunger rod 23 and stub-shaft 24. The feed drum 17 is preferably provided with a plurality of longitudinally spaced annular sheet engaging feed band portions 20a spaced apart by recesses 20b.

A high-speed driven, auxiliary roller means is supported by the rod 23 and the stub-shaft 24, and arranged so that its peripheral surface extends through the opening 26 of the feed drum 17. Such means comprises, in the present instance, a roller 25 of rubber or other suitable friction material and provided with a metal core 27. This core is preferably made in an irregular shape with the roller 25 molded or otherwise secured thereto to prevent any slippage on the core. The opposite ends of the core 27 are engaged by the inner ends of the plunger 23 and the stub-shaft 24. As shown in Fig. 6, the reduced end of the plunger rod 23 is normally retained in an opening of a bushing of the core 27 by a compression spring 28 which surrounds the rod 23. The opposite end of the core 27 is slotted and engaged by the key member 29 fixed on inner end of the stub-shaft 24. The friction roller 25 is adapted to rotate in unison with shaft 24 being rotatably supported at its other end by the plunger 23.

The sectional formation of the supports upon which the friction roller 25 is mounted permits of the removal or replacement in the event of wear or for other reasons without dismantling the feed drum 17. The removal of the friction roller 25 may be accomplished by shifting the plunger rod 23 against the tension of the spring 28 sufficiently to permit disengagement of the key 29, and then removing the core 27 of the roller from reduced end portion of the plunger rod. Upon removal of the roller 25, the return movement of the rod 23 by the tension of the spring 28 is limited by a set screw 30, carried by the boss 18b, which rests in a reduced portion of the rod 23. When the friction roller is to be removed by an outward motion of the plunger 23 it may be taken from within the drum 17 through the opening 26 formed in the body thereof. It will be seen that the roller 25 may be readily replaced by shifting the plunger rod 23 in a manner similar to that just explained.

The stub-shaft 24 is mounted for rotation in the bushing 31a in the boss 19b, and in the bushing 31 on end wall 19. As shown in Fig. 6, the pinion 32 is pinned to the shaft 24 and in meshing engagement with the gear 33 pinned to the fixed shaft 13. The key member 29 and the gear 32, pinned to the shaft 24 on opposite sides of the bushing 31a, prevent lateral displacement of the shaft. A gear 35 is secured to the outer surface of the end wall 19 by means of screws 34, and arranged to mesh with a similar gear 36 pinned to the main drive shaft 37 suitably journaled in the supporting frame 12. The main shaft 37 is normally driven constantly by an electric motor through any suitable operating means or connections, not shown. As the shaft 37 is driven, through its connection with the motor drive means, the gear 36 will rotate the gear 35 secured to the feed drum 17 and effect a counter-clockwise rotation to the drum about the shaft 13.

As the stub-shaft 24 is carried by the drum 17 and the pinion 32 thereon is in meshing engagement with the fixed gear 33, the rotary movement of the drum will impart a counter-clockwise movement to the shaft 24 and the friction roller 25. Since the pinion 32 is considerably smaller than the gear 33, the shaft 24 will be rotated at a greater speed than the feed drum 17. As the shaft sections 23 and 24 are located eccentrically of the drum 17, the periphery of the friction roller at one side will project through the opening 26 formed in the body of the feed member 17. It has been found that a single friction roller 25 arranged at substantially the midpoint of the length of the cylindrical member or drum 17 operates satisfactorily but in certain instances or for feeding wide sheets two or more friction rollers may be used without departing from the spirit of this invention. From Figs. 1 and 4 of the drawings, it will be apparent that as the drum 17 revolves, the friction roller 25 will be moved in unison therewith and the part projecting from the member will be moved in a circular path concentric with the axis of rotation of the drum. The rapidly moving portion of the friction roller 25 projecting from the drum produces a peripheral friction surface which moves in a counter-clockwise direction at a greater speed than the peripheral speed of adjacent portions of the feed drum 17.

The side frames 11 and 12 support a sheet receiver or shelf 38 upon which a stack of sheets of paper or similar items may be placed in order to be fed through the sheet feeding mechanism. The shelf 38 as shown in Figs. 1, 2, and 3, is provided with a vertically extending portion 38a adjacent the frame 12 which acts as a side guide for one end of the sheets. The opposite side of the shelf 38 overhangs frame 11 and extends somewhat beyond the frame of the machine in order to support sheets of various widths. The overhanging portion of the shelf 38 supports an adjustable side guide 39 secured thereto by the bolt 40. This overhanging portion of the shelf 38 is formed with a rearwardly extending portion 38b which serves to support a sheet as it passes through the feed mechanism. The front portion of the shelf 38 is provided with a raised angular section 38c so that when sheets are stacked on the shelf the contour of the shelf will position the sheets in a location favorable to correct feeding by the operating mechanism. The frame 11 does not extend above the path of feed of the sheets through the feeding mechanism and the arrangement permits sheets wider than the space between the frames 11 and 12 to be successfully passed through the mechanism. However, the frame 12 on the opposite side of the machine extends vertically above the path of feed of the sheets and serves to support certain operating parts.

An overhanging frame 41 is secured at one end to the frame 12 by the bolts 42 and serves to support certain parts adapted to operate in conjunction with the feed drum 17. A shaft 45 is provided with a plurality of spaced sheet retracting rollers 46 and arranged so that it may be adjusted towards and from the axis of the feed drum. Referring to Figs. 1 and 2, it will be seen that the brackets 43 are secured at opposite ends of the frame 41 by the screws 44 and each bracket is

recessed for the reception of the plunger journal 49 which rotatably supports reduced ends of the shaft 45. Compression springs 50 tend to hold each journal 49 in engagement with adjusting screws 51 threaded in the heads 52 secured to the brackets 43. The screws 51 are provided with reduced ends which engage in openings provided in the top of the journals 49. The heads 52 are secured to the brackets 43 by suitable screws and provide for readily removing the assembly including the shaft 45 and the rollers 46. The nuts associated with the screws 51 serve to lock the latter in position when the shaft 45 is adjusted with relation to the axis of the feed drum or to bring the rollers 46 in the desired location with respect to the sheet engaging bands 20a of the feed drum. It will be seen that the screws 51 on either side of the frame 41, provide for independent adjustment of the ends of the shaft 45 to properly position the retracting rollers 46 with respect to the surface of the feed drum 17.

The retracting or retarding rollers 46 are of rubber or other friction material having cores 47 with the hubs 48 fast to shaft 45. These rollers are preferably positioned opposite the annular recesses 20b provided in the tubular body 20 of the feed drum 17. The shaft 45 projects beyond the bracket 43 on the right side of the mechanism, as viewed in Fig. 1, and the pinion 53 is secured thereto. Pinion 53 meshes with a similar pinion 54 having a hub fast with a driving gear 55. The pinion 54 and gear 55 are supported on the frame 12 by the stud 55a, and the gear 55 meshes with a gear 56 which is staked to the hub of the gear 35 carried on the end section 19 of the drum 17. Therefore, it will be seen that when the main shaft 37 drives the drum 17 through the gears 35 and 36, the gear 56 meshing with gear 55 will effect rotation of the shaft 45 through gears 53 and 54. As the result of the gearing arrangement, the peripheral surface of the rollers 46 will rotate in counter-clockwise direction and engage the edges and surfaces of the sheets in the course of being fed through the machine to retract the sheets of the stack in the manner to be hereinafter described.

To insure proper successive engagement of the friction roller 25 with the sheets of the stock S, a pressure foot or shoe 61 is provided in the path of movement of the roller. As best seen in Figs. 1 and 4, the extending vertical section 57 of the frame 41, carries a pair of threaded studs 58 upon which the block 59 is adjustably supported. By adjustment of the nuts 60 on the studs 58, the block 59 may be moved to and from the section 57 of the frame 41. The shoe 61 is yieldingly carried by rods 62 and 63, each having one end pivoted to the shoe 61 and the other end passing through suitable holes in the block 59. The ends of the rods 62 and 63 which pass through the block 59 are threaded and provided with lock nuts 64 for adjustment of the shoe 61 with relation to the feed drum 17. Compression springs 65 and 66 surround the rods 62 and 63 and are positioned between the block 59 and the shoe 61 so as to permit either end of the shoe to yield vertically under certain conditions. The spring 66 surrounding rod 63 is slightly stronger than the spring 65 associated with rod 62. Therefore, the resistance on the front of the shoe 61 is somewhat greater than that afforded by spring 65 on the rear part of the shoe.

The pressure foot or shoe 61 in this instance is a metal part having its lower surface preferably curved with an arc somewhat greater than the surface of the feed bands 20a of the drum 17. The front surface 61a of the shoe is rearwardly and inwardly inclined and the shoe itself is adapted to be adjusted so that the inclined edge is in certain relation to the peripheral surface of the retracting rollers 46. This relation is such that rollers 46 and the shoe 61 are adjusted to cause the group of sheets placed on the shelf 38 to taper towards the entering point of the feed mechanism. In view of the fact that the arcuate portion of the shoe is a greater curve than the arc through which the roller 25 passes in its movement with the drum 17, the arrangement provides for the shoe to be adjusted so that the midpoint thereof is normally nearest the axis of shaft 13. Therefore, as the roller 25 moves about its path of travel with the drum 17, its frictional cooperation with the shoe 61 is the greatest at approximately the center of the shoe.

The sheet guide plate 86 suitably secured to lugs 67 of the frame 41 is adapted to partially serve as a cover member for the rollers and parts carried by the frame. However, this guide plate 86 has its lower end 68 curved inwardly and notched to permit portions thereof to extend inwardly of the rollers 46. The guide plate 86 not only assists in keeping the sheet S properly stacked on the shelf 38 but the curved end 68 permits of the lowermost sheets to move somewhat in the direction of the feed and into engagement with the retracting rollers 46.

Take-away or pressure rollers 70 are held in yielding engagement with feed band 20a of the feed drum 17, and in the course of rotation serve to assist in the continued advance of a sheet through the feed mechanism after it has been picked and fed from the stack. The rubber tired rollers 70 are freely mounted on the studs 74 carried by the lower ends of the arms 71. The arms 71 are pivotally supported intermediate their ends at 72 to the lugs 73 formed from the section 57 of the frame 41. Threaded studs 75 carried by section 57 of the frame 41 pass through openings formed in the opposite end of the arms 71, and the compression spring 76 carried on the studs tend to retain the roller in engagement with the drum 17. Adjustment of the studs 75 will permit increase or decrease tension of the springs 76 on the arms 71 so as to vary frictional pressure of the rollers 70 on the drum 17. It will be seen that the arrangement provides for independent adjustment of the arms 71 at either side of the mechanism.

A supplemental sheet advancing or feed means is provided to further assist in the advancement of a sheet through the feed mechanism or into an associated machine. This supplemental means consists of a roller shaft 80 having its ends supported in bushings in the frames 11 and 12. A pinion 81 meshing with the driving gear 36 is pinned to the reduced end of the shaft 80 adjacent the frame 12. A sheet passing through the feeding mechanism is held into engagement with the roller 80 by means of the steel balls 82 loosely carried in openings formed in portions 83 extending from the section 57 of the frame 41. The roller shaft 80 is driven in a counter-clockwise direction, as viewed in Figs. 3 and 5, by the gear 36 carried on the drive shaft 37 so as to positively move sheet in the direction of feed.

From the foregoing the actuation of the sheet feeding mechanism comprising the present invention, as well as the refinements made possible in the operation of a mechanism of this character, will be clear. A stack of sheets of paper

or other articles to be fed in successive order are placed on the receiver or shelf **38**. The raised angular formation **38***c* of the shelf **38** together with the inwardly curved guide plate **68** permit and assist the lowermost sheets of the stack to enter the feed point of the mechanism in the course of operation. Inasmuch as the main supporting surface of the shelf **38** is arranged slightly below the upper portion of the feed drum **17**, one side of the stack of sheets rests on the drum **17**, and the counter-clockwise rotation of the drum tends to constantly effect an advancing movement of the sheets in the direction of the feed. This action on the stack causes the sheets to be brought in engagement with the guide plate **86** and the bottom sheets thereof in contact with the retracting rollers **46**. However, due to the location of the retracting rollers, moving in a direction opposite to the normal path of travel of the sheets, the sheets are temporarily held from movement through the feed mechanism.

The retracting rollers **46** are fixed to the constantly driven shaft **45** and arranged thereon opposite the annular grooves **20***b* in the drum **17**. The roller shaft **45** is preferably adjusted by the screws **51** so that the space between the peripheral surface of the rollers **46** and a plane represented by the outside surface of the feed bands **20***a* of drum **17** is preferably less than the thickness of a sheet. Therefore, while the rotating drum **17** normally tends to pass the sheets through the mechanism, the path of free travel of the sheets is interrupted because of the location of the rollers **46**. It has been found that the retracting rollers **46** function best to retard the feed of the sheets, when adjusted so that the relation between the rollers and the drum **17** is such that a sheet buckles or bends slightly between the portions of the drum formed by the sheet engaging bands **20** as it is passed through the mechanism in the manner to be hereinafter described.

As opposed to the movement of the sheets in an advancing direction by the drum **17**, the retracting rollers **46**, rotating in an opposite direction, act upon the edges of the sheets. It will be seen from Figs. 3 and 7 of the drawings that the retrograde action of the rubber surface rollers **46** not only retards the advancement of the sheets beyond a certain point but, because of their constant action upon the lowermost sheets, they also tend to fan or separate the sheets so that the edges are offset from one another. This fanned-out formation of the lowermost sheets of the stack provides for the presentation of the bottom sheet somewhat ahead of the next adjacent sheet. The wedge shaped or fanned-out formation of the bottom sheets of the stack is maintained as the sheets are successively fed from the bottom of the stack by the feeding mechanism.

As disclosed by Fig. 7 of the drawings, the yieldingly supported pressure foot or shoe **61** is shaped and normally adjusted to permit a limited number of sheets to slightly pass its beveled end **61***a*, under progressively increasing pressure. The sheets are advanced to the latter position in the manner heretofore mentioned by their engagement with the sheet engaging bands **20***a* of the drum **17**. However, the sheets are temporarily held from advancement beyond a certain point by the action of the retarding rolls **46**. It has been found that the friction set up by the rubber surfaced rolls **46** on the surfaces and edges of the lowermost offset sheets of the stack is sufficient to overcome any advancing action on the bottom sheets due to their cooperation with the metal surface of the feed bands **20***a* of the rotating drum **17**, since the metal surface of these bands, which may have any desired degree of smoothness, offers less frictional forward driving force than the retracting or retarding force of the rubber rollers **46**. The bottom sheets of the stack are retained in substantially the position shown in Fig. 7 until successively acted upon by the rapidly rotating friction roller **25**. Upon each rotation of the driven feed drum **17**, the roller **25** is brought into cooperative engagement with the bottom sheet of the stack which is firmly pressed toward the roller by the shoe **61**. The metal surface of the shoe may have any desired degree of smoothness, and the highly frictional contact with the sheet of the rubber roller **25**, as contrasted with the lower frictional grip of the metal shoe **61**, enables the roller, with its relatively high speed and sudden impact, to prevail over the contact of the shoe and initiate a sharp forward feeding movement to the sheet which jerks or picks the bottom sheet from its position in the stack. The positive engagement and sudden jerking action of the friction roller **25** with the bottom sheet of the stack overcomes the resistance placed thereon by the retrograde movement of the retracting rollers **46**. In overcoming this frictional engagement of the rollers **46**, the bottom sheet is moved between the latter rollers and the sheet engaging bands of the drum **17**. In passing through the mechanism at this point, the sheet buckles or bends slightly between the portions of the drum **17** formed by the sheet engaging bands **20**. The retrograde action of the retracting rollers **46**, and the resistance of shoe **61** and plate **86**, upon the remaining lowermost sheets of the stack prevents their advancement through the feeding mechanism. In Fig. 8 the initial action of the high speed friction roller on the lowermost sheet of the stack is diagrammatically disclosed. In this view the bottom sheet has just been jerked or withdrawn from the stack and started on its way for advancement through the feeding mechanism by the impact and speed of the roller **25** cooperating with the pressure shoe **61**.

It will thus be seen that as the lower sheets of the stack approach the feeding point, they are first yieldingly advanced by the metal surfaces or bands **20***a* of the drum, while more strongly retarded by the frictional rubber surfaces of the retarding rollers **46**, aided by the shoe **61** and the curved plate **86**. These parts engage the sheets with relatively light pressure, since the retarding rollers **46** are opposite depressions in the drum **17**, and the shoe **61** is spaced from the drum. These parts thus operate to position the sheets with progressively advanced edges, so as to condition them for subsequent feeding actuation, without, however, actually feeding them through the mechanism.

As the auxiliary rubber roller **25** impacts the bottom sheet, however, the conditions are, in effect, reversed. The lowermost sheet is engaged with substantial pressure between the projecting roller **25** and the shoe **61**. The highly frictional contact of the rapidly moving rubber roller prevails over the retarding effect of the smoother metal surface of the shoe and the low pressure of the rollers **46**, with the result that the roller **25** takes control and projects the lowermost sheet rapidly forward through the mechanism. As

each sheet approaches the feeding point, therefore, it is first engaged at a lower pressure by a retarding element of high frictional contact in opposition to an advancing element of low frictional contact. As it becomes the lowermost sheet, however, it is engaged at higher pressure between a retarding element of lower frictional contact and an advancing element of higher frictional contact, with the result of effective control of the sheets throughout the operation.

It will also be noted that the roller **25** has both the rotary feeding movement of the drum **17** on which it is mounted and also its own additional rotation relative to the drum, which gives it a combined, rapid feeding motion, and also a definite and substantial length of contact with the lowermost sheet.

The shoe **61** having an arcuate surface is preferably adjusted so that the frictional engagement of the roller **25** with a sheet is the greatest at approximately midway between the ends of the shoe. This point is substantially in alignment with a point corresponding to that where the retracting rollers **46** normally engage the advanced edge of the bottom or the next to the bottom sheets of the stack. It has been found by this arrangement that in the event the rapidly rotating frictional roller **25** through its engagement with the bottom sheets and the shoe **61** tends to advance more than one sheet, the action of the retracting rollers **46** upon the edges of any sheet, other than the bottom sheet, is sufficient to overcome the tendency of the friction roller **25** to advance more than a single sheet. This result is aided by the provision of frictional surfaces for the different parts of different materials, that is, it is found that the engagement of the rubber friction surface of the roller **25** with the bottom sheet, especially in that the roller is driven at high speed, positively effects withdrawal of the sheet from the stack and moves it in the direction of feed. The metallic curved surface of the stationary shoe **61** has been found to provide sufficient friction upon the sheets, other than the bottom sheet, to overcome any tendency of the sheets to be advanced with the bottom sheet when the latter is engaged by the friction roller **25**. The action of the shoe together with the retracting roller **46** upon the sheets next to the bottom sheet has been found to provide an arrangement which is successful and efficient in limiting the advancement to only a single sheet at a time.

The length of the lower sheet engaging portion of the shoe **61** permits the rapidly driven friction roller **25** to remain in positive engagement with the advanced sheet through a substantial part of its movement about the axis of the shaft **13**. The provision of the extended surface of the shoe has not only been found effective to assure the successful removal of the bottom sheet from the stack but the cooperative engagement of the high speed friction roller **25** therewith increases the rate of speed at which sheet may be efficiently handled. The initial cooperative engagement of the roller **25** with the shoe serves primarily for assuring positive frictional contact of the roller with the lowermost sheet so that it may be effective in removing the sheet from the stack. However, after the sheet has been started on its initial movement from the stack by the feed mechanism, it is desirable to pass the sheet from the mechanism at as rapid speed as possible. Therefore, it has been found that an arrangement wherein the rapidly rotating roller **25** is retained in engagement with the sheet beyond its initial feed point not only assures a more positive feeding action but the passage of the sheet is accelerated by the speed of the friction roller. While the lower surface of the shoe **61** has been shown in its preferred arcuate form, this sheet supporting surface may be provided in a variety of shapes. A straight surfaced shoe, adjusted at an angle, has been found to give satisfactory results.

The arrangement of the rapidly revolving friction roller **25** cooperating with the pressure shoe **61**, together with the other parts of the feeding mechanism previously described, provides for positively feeding a sheet from a stack in uniform timed sequence, that is, a sheet is picked from the stack at substantially the same point during the operating cycle of the feed mechanism. This provision is not only essential with a feed mechanism which actuates at a high rate of speed but is highly desirable when a feed mechanism is operatively connected with an associate machine regardless of the rate of speed of the feeder. The presentation of a sheet to an associated machine in proper timed sequence is highly desirable, especially if the machine is automatic or partially automatic. While stationary friction feed pads and rollers have heretofore been provided in combination with feed cylinders, it is well known in the art that the gripping point of such friction means varies and is dependent largely upon the condition of the surface of the pads or rollers. Therefore, the latter type of friction means have not been found to feed a sheet from a stack at any definite point in the cycle of operation of the feed mechanism in which they have been embodied.

The action of the friction roller **25** on the sheet that is being fed from the stack provides for advancement of the sheet to the take-away rollers **70**. The extending portion **38b** of the sheet receiver or shelf **38** assists in the guidance of the sheet to the roller shaft **80** and its continued advancement through the feeding mechanism or into an associated operating machine. The provision of the stronger spring **66** acting upon the front of the shoe **61** has been found to assist in the initial action of the roller **25** in separating and snatching a sheet from the stack. The weaker spring **65** acting upon the rear portion of the shoe, obviously provides adequate resistance for positive contact of the roller **25** with the sheet. However, pressure afforded by the spring **65** is not sufficient to cause the sheet to be retarded after it is passed between the take-away roller **70** or advancing means **80** and **82**. The preferred form of the arcuate surface of the shoe **61** permits the pressure of the shoe to be eased off as the roller **25** reaches the rear portion. The shoe **61** may also be adjusted longitudinally of the direction of feed or vertically to position its arcuate surface in the desired position with respect to the path of travel of the roller **25**.

I claim:

1. In a sheet feeding apparatus, a rotary feeding member arranged to engage and feed a sheet, an auxiliary feeding means mounted in bearings associated and rotatable with said member, said feeding means having its periphery projecting radially adjacent the periphery of said member, means for rotating said member, mechanism for rotating said feeding means in said bearings relative to said member to engage and feed a sheet, and retarding means yieldably engaging

said sheets to resist the passage of more than one of them into the machine at one time.

2. In a sheet feeding apparatus, a rotary feeding member of relatively hard material arranged to engage and feed a sheet but offering relatively low frictional engagement, an auxiliary feeding roller of relatively soft material offering relatively high frictional engagement, said roller being mounted in bearings associated and rotatable with said member with the periphery of said roller projecting radially adjacent the periphery of said member, means for rotating said member, mechanism operated by the rotation of said member for rotating said roller in said bearings relative to said member to engage and feed a sheet, and retarding means yieldably engaging said sheets to resist the passage of more than one of them into the machine at one time.

3. In a sheet feeding apparatus, a rotary feeding drum arranged to engage and feed a sheet, an auxiliary feeding roller mounted in bearings associated and rotatable with said drum with its periphery projecting radially adjacent an opening in the periphery of said drum, means for rotating said drum, mechanism operated by the rotation of said drum for rotating said roller relative to said drum to engage and feed a sheet, and retarding means yieldably engaging said sheets to resist the passage of more than one of them into the machine at one time.

4. In a sheet feeding apparatus, a rotary feeding drum arranged to engage and feed a sheet, a shaft journaled in said drum in parallel offset relationship with the longitudinal axis thereof, means for rotating said drum, means operated by the rotation of said drum for rotating said shaft relative to said drum, a roller of frictional material fixed on said shaft with its periphery projecting radially adjacent the periphery of said member to engage and feed a sheet, and retarding means yieldably engaging said sheets to resist the passage of more than one of them into the machine at one time.

5. In a sheet feeding apparatus, a rotary feeding member arranged to engage and feed a sheet but having a surface of material of relatively low frictional engagement, means for rotating said member, a shaft journaled in said member in parallel offset relationship with the longitudinal axis thereof, a frictional roller secured on said shaft with its periphery projecting radially adjacent the periphery of said member, means operated by the rotation of said member for rotating said shaft and roller relative to said member to engage and feed a sheet, and retarding means yieldably engaging said sheets to resist the passage of more than one of them into the machine at one time.

6. In a sheet feeding apparatus, a rotary feeding member having a surface for engaging and positioning the sheet, retarding means arranged to engage the sheets and resist the feeding of the same through said machine by said member, an auxiliary frictional feeding roller mounted in bearings associated and rotatable with said member and having its periphery projecting radially adjacent said surface of said member, means for rotating said member, mechanism for rotating said roller relative to said member for feeding engagement with the adjacent one of said sheets, and a pressure device adjacent the path of said roller for engaging the opposite side of a sheet to press the same into feeding contact therewith.

7. In a sheet feeding apparatus, a rotary member having spaced feeding surfaces, retarding means intermediate and spaced from said surfaces for engaging the sheets to resist the feeding of the same through said machine by said surfaces, an auxiliary feeding roller mounted in bearings associated and rotatable with said member with the periphery of said roller projecting radially adjacent said surfaces, means for rotating said member, and mechanism operated by the rotation of said member for rotating said roller relative to said member to engage and feed a sheet.

8. In a sheet feeding apparatus, a rotary member having spaced feeding surfaces of material of relatively low frictional engagement, retarding means intermediate and spaced from said surfaces for engaging the sheets to resist the feeding of the same through said machine by said surfaces, an auxiliary feeding roller of material of high frictional engagement mounted in bearings associated and rotatable with said member with the periphery of said roller projecting radially adjacent the periphery of said member, means for rotating said member, and mechanism for rotating said roller relative to said member to engage and feed a sheet.

9. In a sheet feeding apparatus, a rotary member having spaced feeding surfaces of material of relatively low frictional engagement, a retarding roller of frictional material intermediate and spaced from said surfaces for engaging the sheets to resist the feeding thereof through said machine by said surfaces, an auxiliary feeding roller of frictional material mounted in bearings associated and rotatable with said member with the periphery of said auxiliary roller projecting radially adjacent said surfaces, means for rotating said member and mechanism operated by the rotation of said member for rotating said auxiliary roller relative to said member.

10. In a sheet feeding apparatus, a rotary member having spaced feeding surfaces, retarding means intermediate and spaced from said surfaces for engaging the sheets to resist the feeding thereof through said machine by said surfaces, an auxiliary feeding roller mounted in bearings associated and rotatable with said member with the periphery of said roller projecting radially adjacent said surfaces, means for rotating said member, mechanism operated by the rotation of said member for rotating said roller relative to said member and in the same direction, and a pressure device adjacent the path of said roller and intermediate said surfaces for engaging a sheet on the side thereof opposite said roller for pressing the same into feeding contact therewith.

11. In a sheet feeding apparatus, a rotary member having a feeding surface of relatively low frictional engagement, retarding frictional roller means spaced from the path of said surface for engaging the sheets to resist the feeding thereof through said machine by said feeding surface, an auxiliary feeding roller of relatively frictional material mounted for rotation bodily with said member with its periphery projecting radially to position for engaging one of said sheets, means for rotating said member, mechanism for rotating said feeding roller relative to said member and in the same direction, and a pressure device of relatively low frictional engagement positioned adjacent the path of said feeding roller for engaging the opposite side of a sheet for pressing the same into feeding contact with said roller.

12. In a sheet feeding apparatus, a rotary feed-

ing member, auxiliary feeding roller means rotatable bodily with said member with its periphery projecting radially adjacent the periphery of said member, retarding roller means for engaging the sheets to resist the feeding of the same through said machine by said member, means for rotating said member, mechanism for rotating said feeding roller means relative to said member, and mechanism for rotating said retarding roller means in the same direction as the rotation of said member.

13. In a sheet feeding apparatus, a rotary feeding member of relatively low frictional engagement, retarding means of relatively high frictional engagement for resisting the feeding of the sheets through the machine by said member, an auxiliary feeding means of relatively high frictional engagement mounted for rotation bodily with said member, with its periphery projecting radially adjacent the periphery of said member, means for rotating said member, mechanism for rotating said retarding means and auxiliary feeding means relative to said member and in the same direction, and a pressure device of relatively low frictional engagement positioned adjacent the path of movement of said auxiliary feeding means for engaging the opposite side of a sheet to press the same into feeding contact therewith.

14. In a sheet feeding apparatus, a rotary member having a feeding surface, retarding roller means spaced from the path of said surface, auxiliary roller feeding means mounted for rotation bodily with said member with its periphery projecting radially adjacent said surface, means for rotating said member, mechanism for rotating said retarding roller means and said feeding roller means relative to said member and in the same direction, and a pressure device located adjacent the path of said feeding roller means for engaging the opposite side of a sheet to press the same into contact therewith.

15. In a sheet feeding apparatus, a rotary feeding member having a feeding surface, retarding rollers spaced from and on opposite sides of the path of said surface, a feeding roller mounted for rotation bodily with said member with its periphery projecting radially adjacent said surface, means for rotating said member, and mechanism for rotating said retarding rollers and said feeding roller relative to said member and in the same direction.

16. In a sheet feeding apparatus, a rotary member having spaced feeding surfaces, retarding rollers intermediate and spaced from the paths of said surfaces for lightly engaging a sheet to resist the feeding thereof through said machine by said surfaces, an auxiliary feeding roller mounted for rotation bodily with said member with its periphery projecting radially to position to engage a sheet, means for rotating said member, and mechanism for rotating said retarding rollers and said feeding roller relative to said member and in the same direction.

17. In a sheet feeding apparatus, a rotary member having spaced feeding surfaces, retarding rollers intermediate and spaced from said surfaces for lightly engaging a sheet to resist the feeding thereof through said machine by said surfaces, an auxiliary feeding roller rotatable bodily with said member, means for rotating said member, mechanism for rotating said retarding rollers and said feeding roller relative to said member and in the same direction, and a pressure surface yieldably supported in stationary bearing means adjacent the path of movement of said feeding roller for engaging the opposite side of a sheet to press the same into feeding contact therewith.

18. In a sheet feeding apparatus, a rotary feeding member, an auxiliary feeding roller mounted for rotation bodily with said member with its periphery projecting radially for engagement with a sheet, means for rotating said member, mechanism for rotating said feeding roller relative to said member and in the same direction, and roller means yieldably and adjustably mounted adjacent the path of said member for holding a sheet to be fed in engagement therewith.

19. In a sheet feeding mechanism, a rotary feeding member arranged to engage and feed a sheet, a feeding roller rotatable bodily with said member with its periphery projecting radially for engagement with a sheet, means for rotating said member, mechanism for rotating said feeding roller relative to said member and in the same direction, idler roller means yieldably and adjustably mounted adjacent the path of movement of said member for holding a sheet to be fed in engagement therewith, and means comprising a driven roller and a cooperating idler roller for feeding a sheet away from said member.

20. In a sheet feeding apparatus, a rotary feeding member, retarding roller means for engaging the sheets to resist the feeding thereof through said machine by said member, a feeding roller rotatable bodily with said member with its periphery projecting radially for engagement with a sheet, means for rotating said member, mechanism for rotating said retarding roller means and said feeding roller relative to said member and in the same direction, a stationary pressure device adjacent the path of movement of said feeding roller for pressing a sheet into feeding contact therewith, an idler roller for maintaining a sheet in contact with said member during the feeding thereof, and roller means comprising driven and idler rollers for feeding a sheet away from said member.

21. In a sheet feeding apparatus, a support for receiving a stack of sheets to be fed, a rotary member having a surface arranged to engage and feed one of said sheets in a predetermined direction, auxiliary roller feeding means mounted for rotation bodily with said member and having its periphery projecting radially adjacent the path of said surface for engagement with said sheet to move the same in said predetermined direction, means for rotating said member and a device independent of said support and arranged adjacent the path of said auxiliary roller means for engaging the opposite side of a sheet to press the same into feeding contact with said roller means.

22. In a sheeet feeding apparatus, a support for a stack of sheets to be fed, a rotary member having a surface arranged to engage and feed one of said sheets, auxiliary roller feeding means of frictional material mounted for rotation bodily with said member and having its periphery projecting radially adjacent the path of said surface for engagement with said sheet to be fed, means for rotating said member, mechanism for rotating said auxiliary roller means relative to said member, and a device arranged adjacent the path of said auxiliary roller means for yieldable frictional engagement with the opposite side of

a sheet to press the same into feeding contact therewith.

23. In a sheet feeding apparatus, a support for a stack of sheets to be fed in successive order therefrom, a rotary feeding member arranged to engage and feed the adjacent sheet of said stack, retarding means arranged to engage certain of the sheets of said stack and yieldably resist the feeding of the same through said machine by said member, auxiliary feeding means mounted in association and rotatable with said member, said feeding means projecting radially adjacent the periphery of said member for engagement with said sheet, means for rotating said member, mechanism for rotating said feeding means relative to said member to engage and feed a sheet from said stack, and a pressure device positioned adjacent the path of said feeding means for engaging the opposite side of a sheet to press the same into contact therewith.

24. In a sheet feeding apparatus, a support for a stack of sheets to be fed in successive order therefrom, a rotary feeding member arranged to engage and feed the adjacent sheet of said stack in a predetermined direction, auxiliary feeding means mounted in association and rotatable with said member, said feeding means projecting radially adjacent the periphery of said member for engagement with said sheet, means for rotating said member, and mechanism for rotating said feeding means to move said sheet in said predetermined direction to initiate the feeding movement thereof.

25. In a sheet feeding apparatus, a support for a stack of sheets to be fed in successive order therefrom, a rotary feeding member arranged to engage and feed the adjacent sheet of said stack, auxiliary feeding means mounted in association and rotatable with said member, said feeding means projecting radially adjacent the periphery of the said member for engagement with said sheet, means for rotating said member, and mechanism for rotating said feeding means in the same direction as said member but at a higher speed.

26. In a sheet feeding apparatus, a support for a stack of sheets to be fed in successive order therefrom, a rotary feeding member having spaced feeding surfaces arranged to engage and feed the adjacent sheet of said stack, retarding means including spaced parts arranged opposite the spaces between said feeding surfaces, said retarding means being adapted and arranged to engage certain of the sheets of said stack and yieldably resist the feeding of the same through said machine by said member, auxiliary feeding means mounted in association and rotatable with said member intermediate said spaced parts of said retarding means, said feeding means projecting radially adjacent the periphery of said member for engagement with said sheet, means for rotating said member, and mechanism for rotating said feeding means relative to said member to engage and feed a sheet from said stack, and a pressure device positioned adjacent the path of said feeding means for engaging the opposite side of a sheet to press the same into feeding contact therewith.

27. In a sheet feeding apparatus, a support for a stack of sheets to be fed in successive order therefrom, a rotary feeding member arranged to engage and feed the adjacent sheet of said stack, retarding means having spaced feeding parts arranged to engage certain of the sheets of the said stack and yieldably resist feeding of the same through said machine by said member, auxiliary feeding means mounted intermediate the ends of said member and rotatable therewith, said feeding means projecting radially adjacent the periphery of said member for engagement with said sheet, means for rotating said member, mechanism for rotating said feeding means relative to said member to engage and feed said sheet, and a pressure device mounted adjacent the path of said feeding means for engaging the opposite side of a sheet to press the same into feeding contact therewith.

28. In a sheet feeding apparatus, a support for a stack of sheets to be fed in successive order therefrom, a rotary feeding cylinder provided with an opening intermediate its ends, said cylinder having longitudinally spaced annular feeding surfaces on either side of said opening, to engage and feed the adjacent sheet of said stack, retarding means having parts opposite certain of the spaces between said feeding surfaces to engage certain of the sheets of said stack and yieldably resist the feeding of the same through said machine by said feeding surfaces, an auxiliary feeding roller mounted on said cylinder and rotatable bodily relative thereto, said feeding roller having its periphery projecting partly through said opening beyond the periphery of said cylinder for engagement with said sheet, means for rotating said cylinder, mechanism for rotating said feeding roller relative to said cylinder to engage and feed said sheet, and a pressure device mounted adjacent the path of said feeding roller for engaging the opposite side of a sheet to press the same into feeding contact therewith.

29. In a sheet feeding apparatus, retarding means for yieldably resisting the passage of a sheet through said apparatus, a rotary device arranged to engage and feed said sheet to said retarding means, an auxiliary feeding means rotatable relative to said device, said auxiliary means having its periphery projecting radially adjacent the periphery of said device, means for rotating said device, and mechanism for rotating said auxiliary means to engage said sheet and overcome the resistance of said retarding means and thereby effect the feeding of said sheet.

30. In a sheet feeding apparatus, retarding means for yieldably resisting the passage of a sheet through said apparatus, a rotary device of relatively hard material offering relatively low frictional engagement and arranged to engage and feed a sheet to said retarding means, an auxiliary feeding means of relatively soft material offering relatively high frictional engagement and rotatable relative to said device, said feeding means having its periphery projecting radially adjacent the periphery of said device, means for rotating said device, and mechanism for rotating said feeding means to engage said sheet and overcome the resistance of said retarding means and thereby effect the feeding of said sheet.

31. In a sheet feeding apparatus, retarding means for yieldably resisting the passage of a sheet through said apparatus, a rotary device arranged to engage and feed a sheet to said retarding means, an auxiliary feeding means mounted in bearings associated and rotatable with said device, said feeding means having its periphery projecting radially adjacent the periphery of said device, means for rotating said device, and mechanism for rotating said feeding means relative to said device to engage said sheet and overcome the resistance of said retarding means and thereby effect the feeding of said sheet.

32. In a sheet feeding apparatus, retarding means, a rotary drum arranged to engage and feed a sheet to said retarding means, an auxiliary feeding roller mounted in bearings associated and rotatable with said drum with its periphery projecting radially adjacent an opening in the periphery of said drum, mechanism operated by the rotation of said drum for rotating said roller relative to said drum, and means for rotating said drum to engage and feed a sheet past said retarding means.

33. In a sheet feeding apparatus, retarding means, a rotary drum for engaging and feeding a sheet to said retarding means, a shaft journaled in said drum in parallel offset relation with the longitudinal axis thereof, means for rotating said drum, means operated by the rotation of said drum for rotating said shaft relative to said drum, and a roller of frictional material fixed on said shaft with its periphery projecting radially adjacent the periphery of said drum to engage and feed a sheet past said retarding means.

34. In a sheet feeding apparatus, retarding means, a rotary member having a surface of material of relatively low frictional engagement and arranged to engage and feed a sheet to said retarding means, means for rotating said member, a shaft journaled in said member in parallel offset relation with the longitudinal axis thereof, a frictional roller secured on said shaft with its periphery projecting radially adjacent the periphery of said member, and means operated by the rotation of said member for rotating said shaft and roller relative to said member to engage and feed a sheet past said retarding means.

35. In a sheet feeding apparatus, a rotary feeding member having a surface for engaging and positioning a sheet, retarding means arranged to engage the sheets and resist the feeding of the same through said apparatus by said member, an auxiliary frictional feeding roller having its periphery projecting radially adjacent the periphery of said member, mechanism for rotating said roller relative to said member, means for rotating said member, and a pressure device adjacent the path of said roller for engaging the opposite side of a sheet to press the same into feeding contact therewith.

36. In a sheet feeding apparatus, a rotary member arranged to engage and feed a sheet, retarding roller means for yieldably resisting the feeding action of said member, auxiliary roller feeding means mounted within the peripheral outline of said member but projecting radially adjacent said outline in position to engage and feed said sheet past said retarding means, and a pressure device located adjacent the path of said auxiliary roller means for engaging the opposite side of said sheet to press the same into contact therewith.

37. In a sheet feeding apparatus, a rotary member arranged to engage and feed a sheet, retarding roller means rotatable in a direction for yieldably resisting the feeding action of said member, auxiliary roller feeding means mounted within the peripheral outline of said member but projecting radially adjacent said outline in position to engage and feed said sheet past said retarding means, and a pressure device located adjacent and curved to substantially conform to the path of said auxiliary roller means for engaging the opposite side of said sheet to press the same into contact therewith.

38. In a sheet feeding apparatus, a rotary member having a continuous circumferential surface arranged to engage and feed a sheet, retarding roller means rotatable in a direction for yieldably resisting the feeding action of said member, auxiliary roller feeding means rotatably mounted within the peripheral outline of said member but projecting radially adjacent said outline in position to engage and feed said sheet past said retarding means, and a spring actuated pressure device yieldably located adjacent and curved to substantially conform to the path of said auxiliary roller means for engaging the opposite side of said sheet to press the same into contact therewith.

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