May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 1

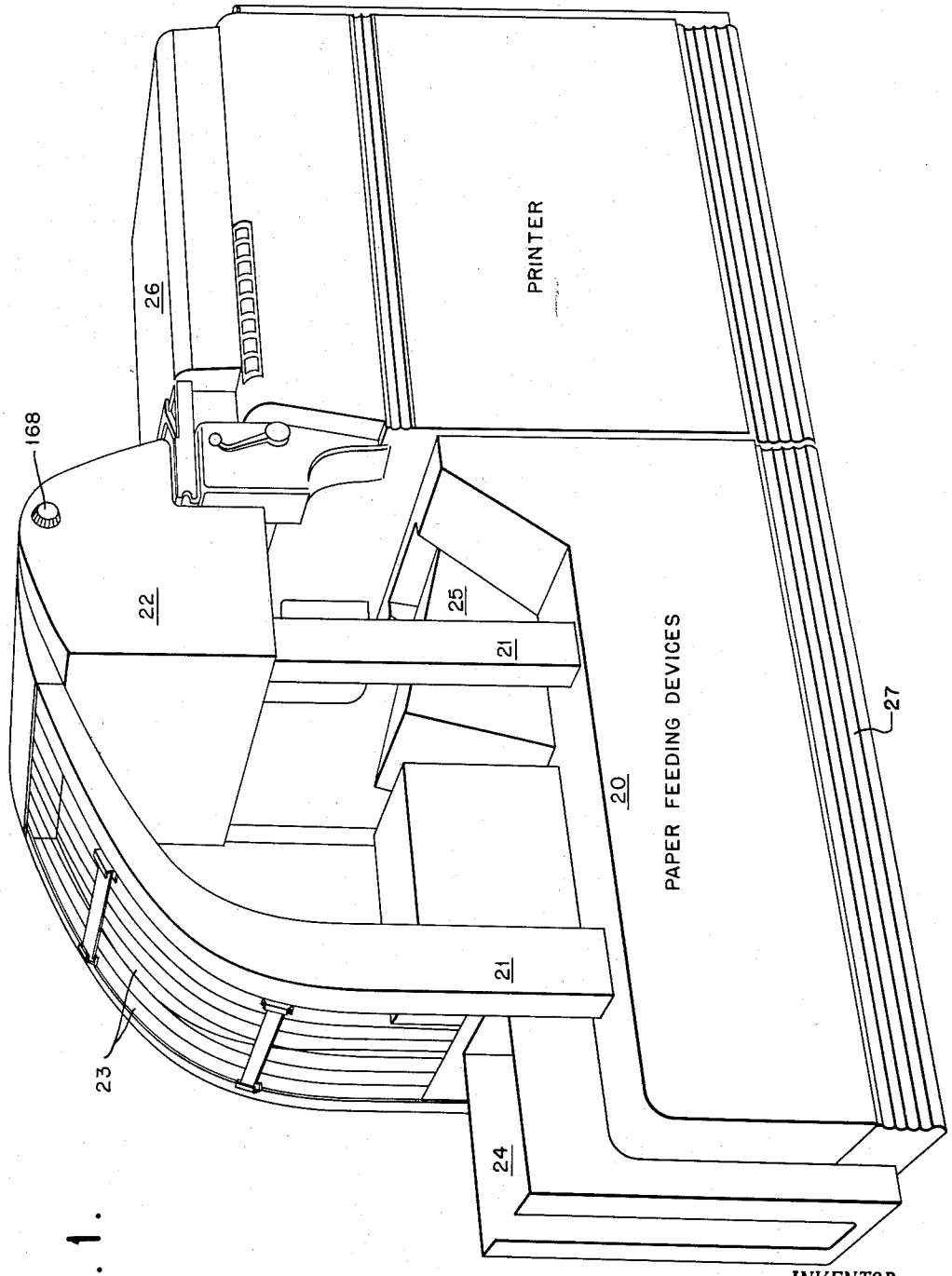



FIG. 1.

INVENTOR.
J. M. CUNNINGHAM
F. L. PRATT
P. M. KOVACH

BY

J W Armbruster

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 2

FIG. 3.

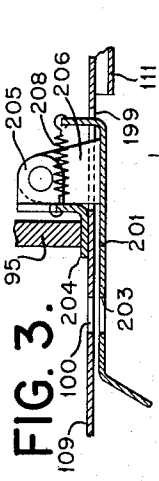



FIG. 2.




INVENTOR.
J. M. CUNNINGHAM
F. L. PRATT
P. M. KOVACH

BY

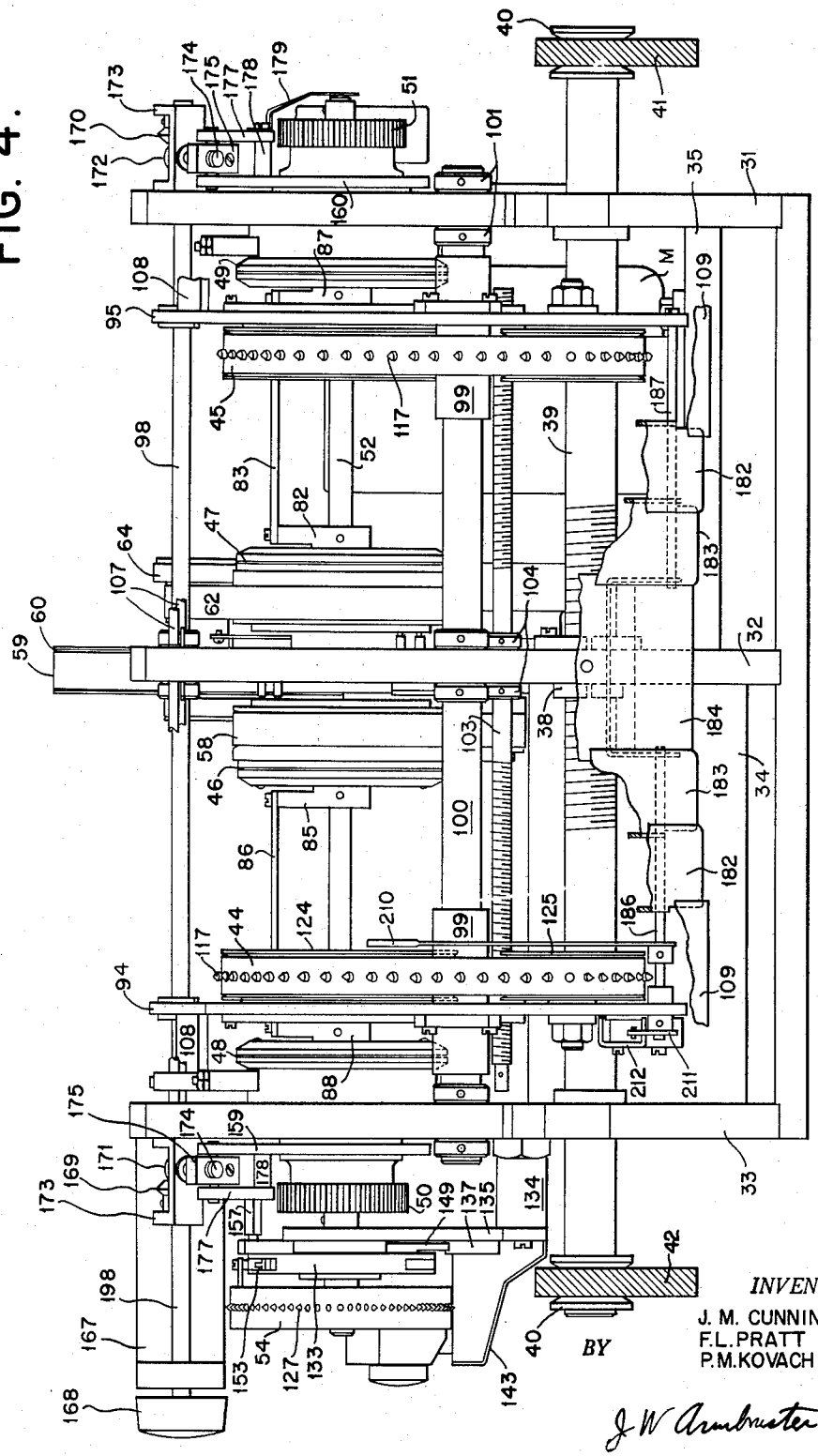
J W Armbruster

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 3

FIG. 4.




INVENTOR.
J. M. CUNNINGHAM
F.L. PRATT
P.M. KOVACH

BY

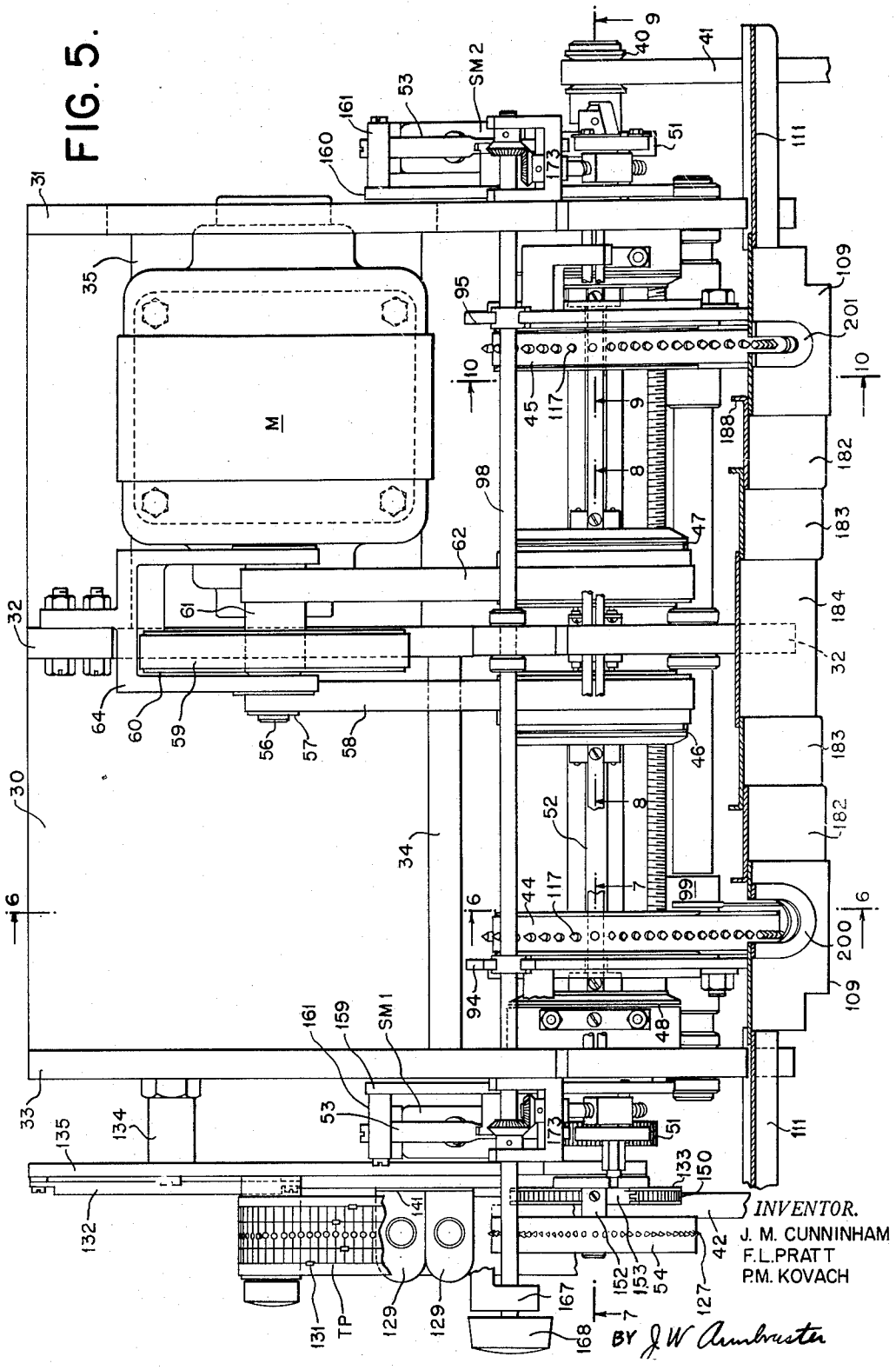
J W Armbruster

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 4

FIG. 5.



May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 5

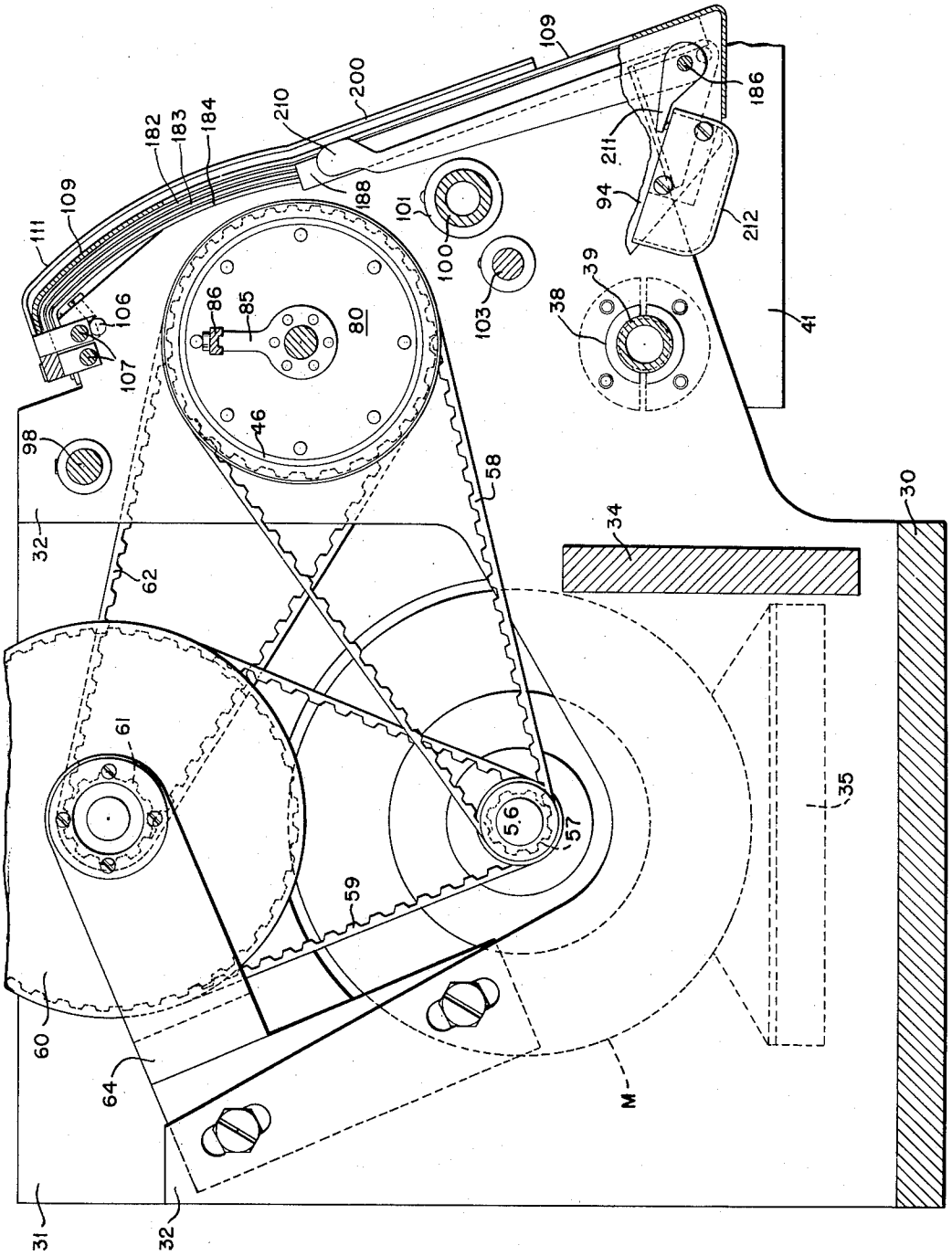



FIG. 6.

INVENTOR.
J. M. CUNNINGHAM
F. L. PRATT
P. M. KOVACH

BY

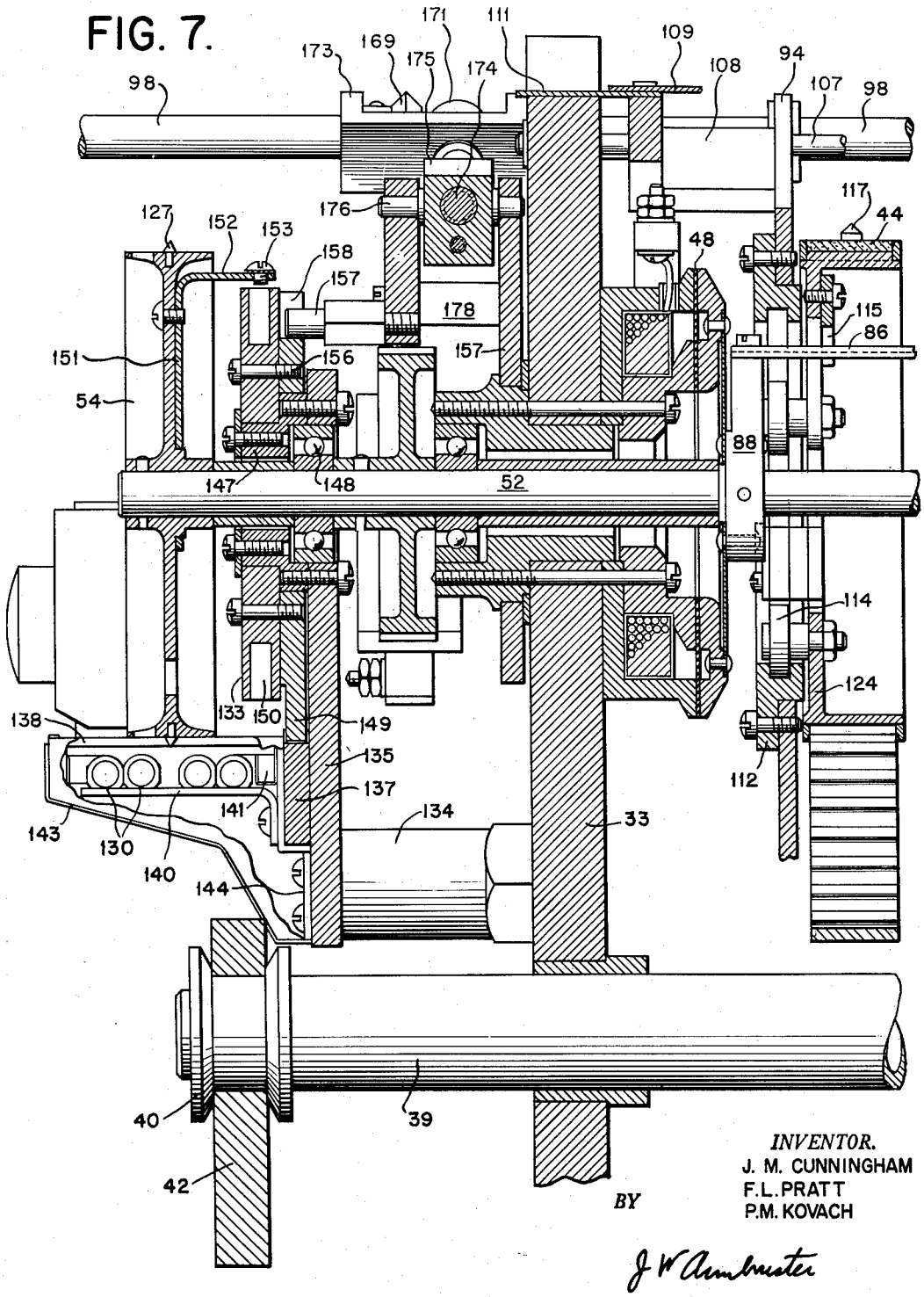
J W Armbruster

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 6

FIG. 7.




*INVENTOR.*
J. M. CUNNINGHAM
F. L. PRATT
P. M. KOVACH

*BY*

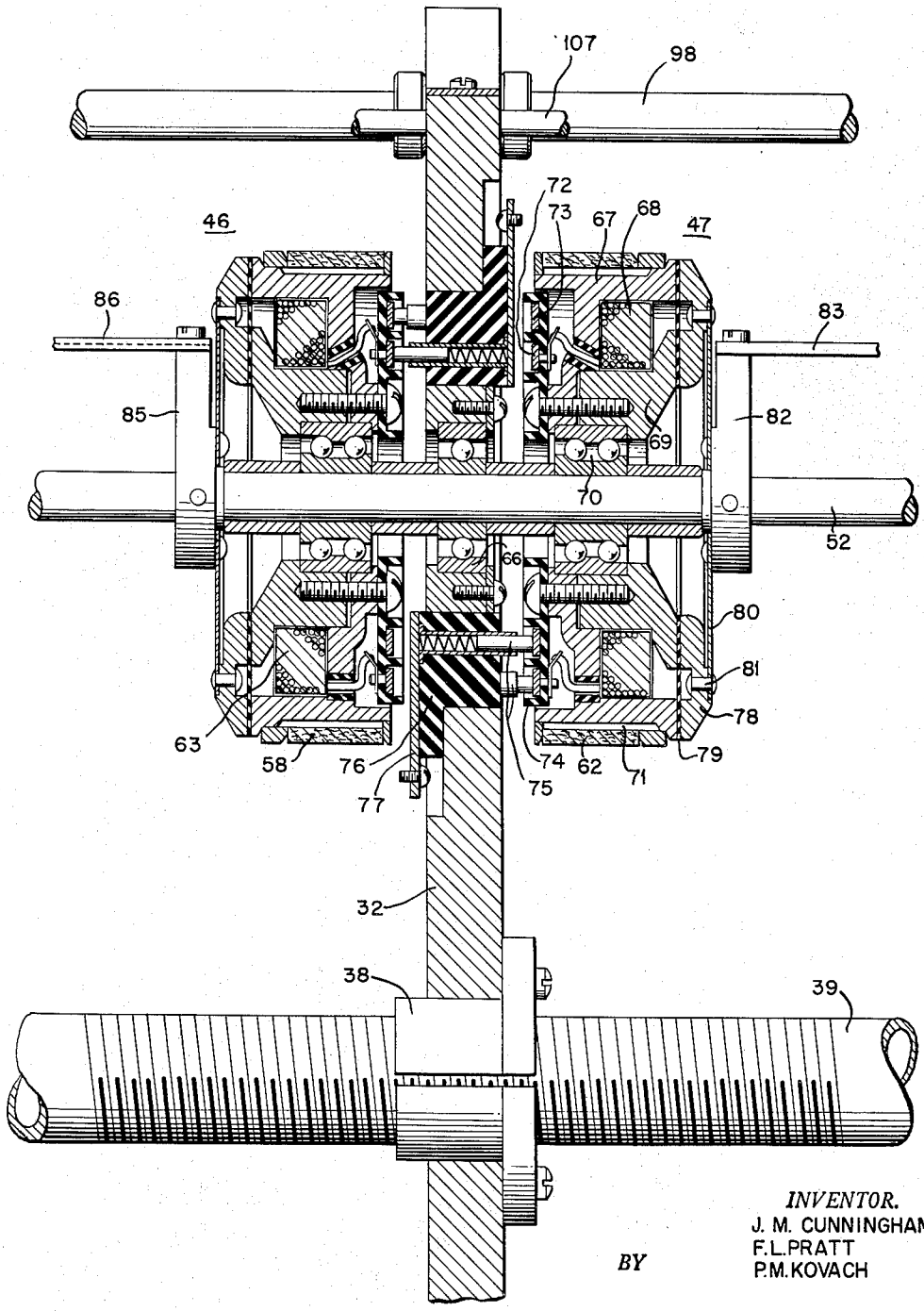
J. W. Armbruster

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 7

FIG. 8.




*INVENTOR.*
J. M. CUNNINGHAM
F. L. PRATT
P. M. KOVACH

*BY*

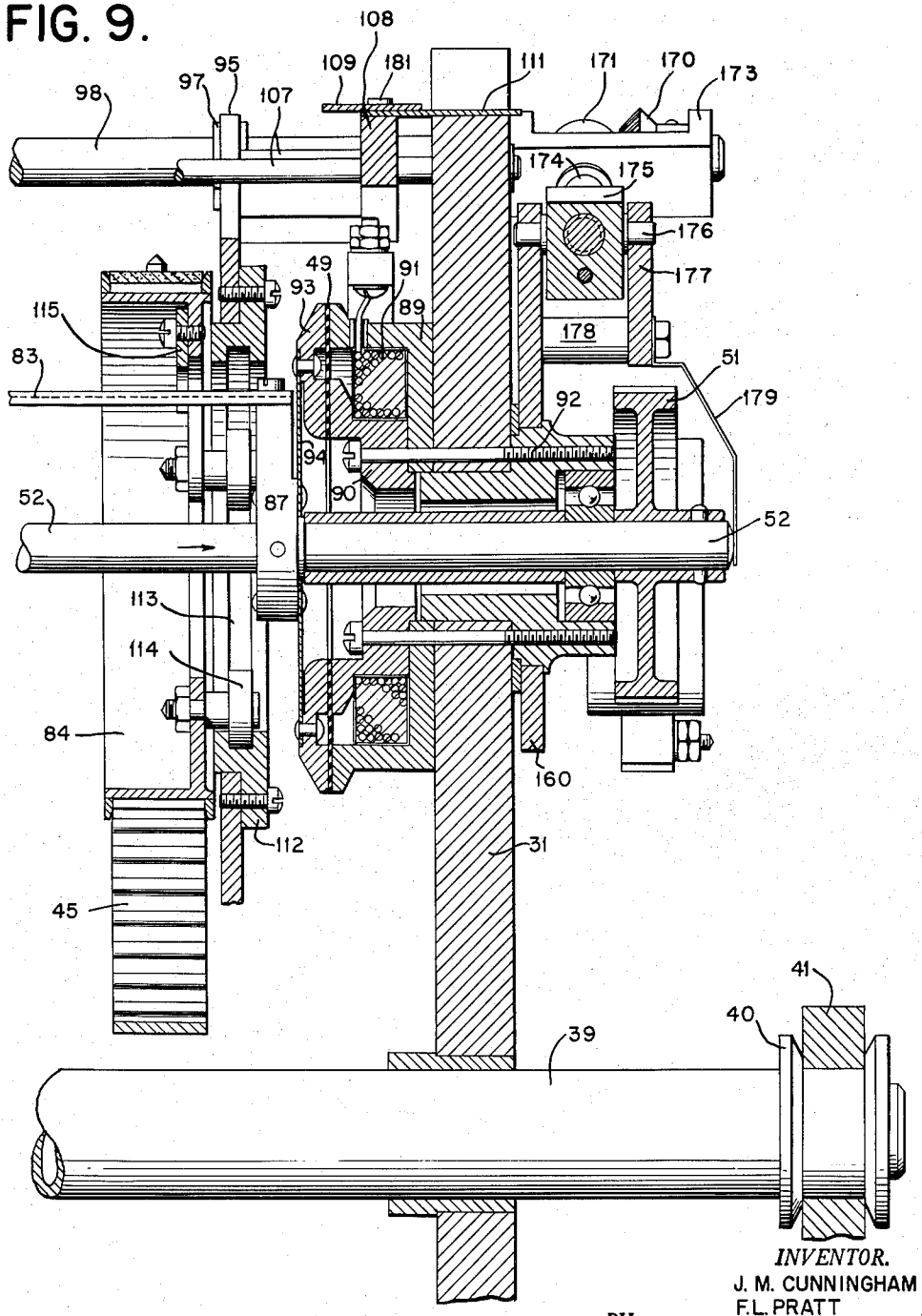
J W Armbruster

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 8

FIG. 9.




INVENTOR.
J. M. CUNNINGHAM
F. L. PRATT
P. M. KOVACH

BY

J W Armbruster

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 9

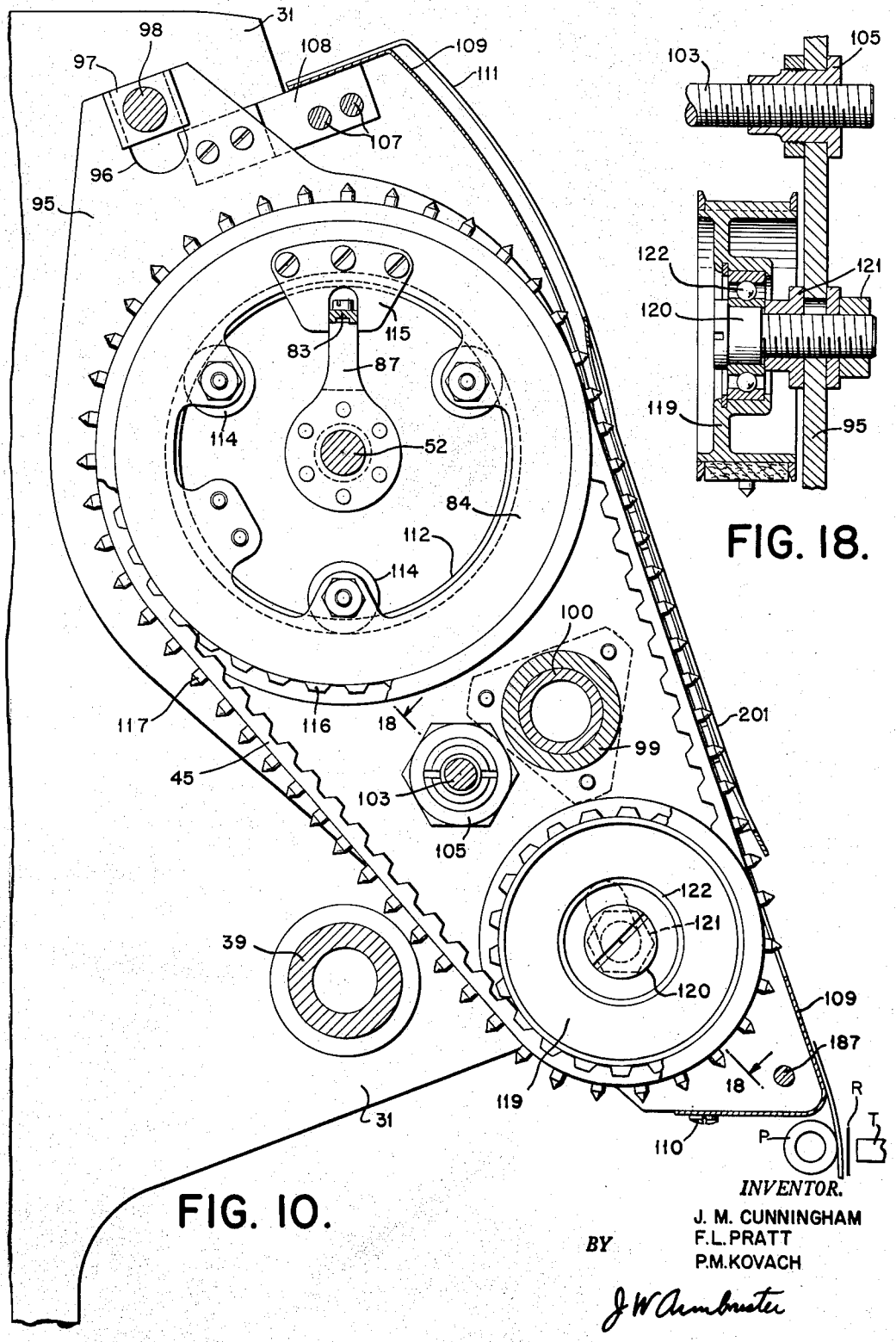



FIG. 10.




FIG. 18.

INVENTOR.
J. M. CUNNINGHAM
F. L. PRATT
P. M. KOVACH

BY

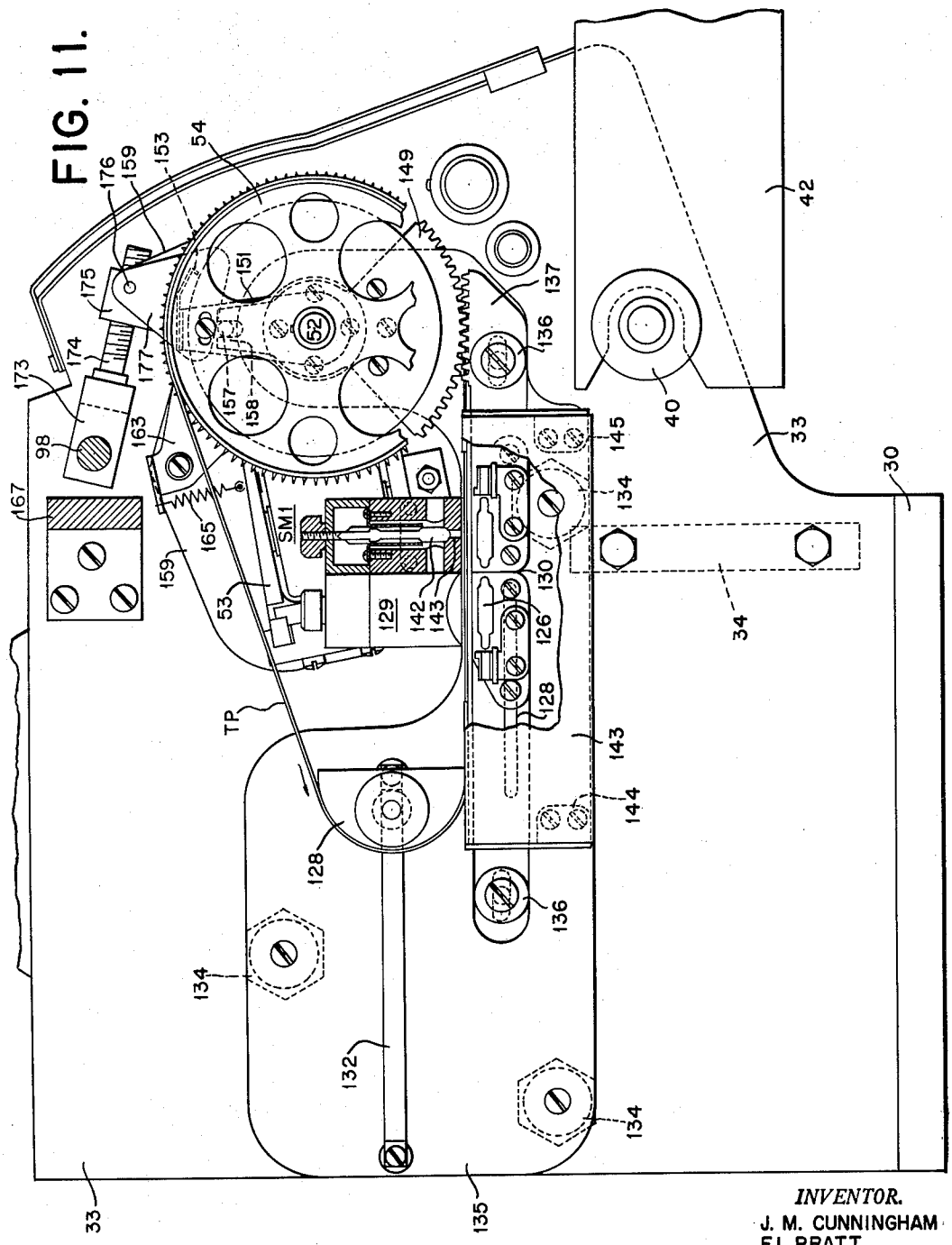
J W Armbruster

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 10

FIG. 11.




*INVENTOR.*
J. M. CUNNINGHAM
F.L.PRATT
P.M.KOVACH

*BY*

J W Armbruster

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 11

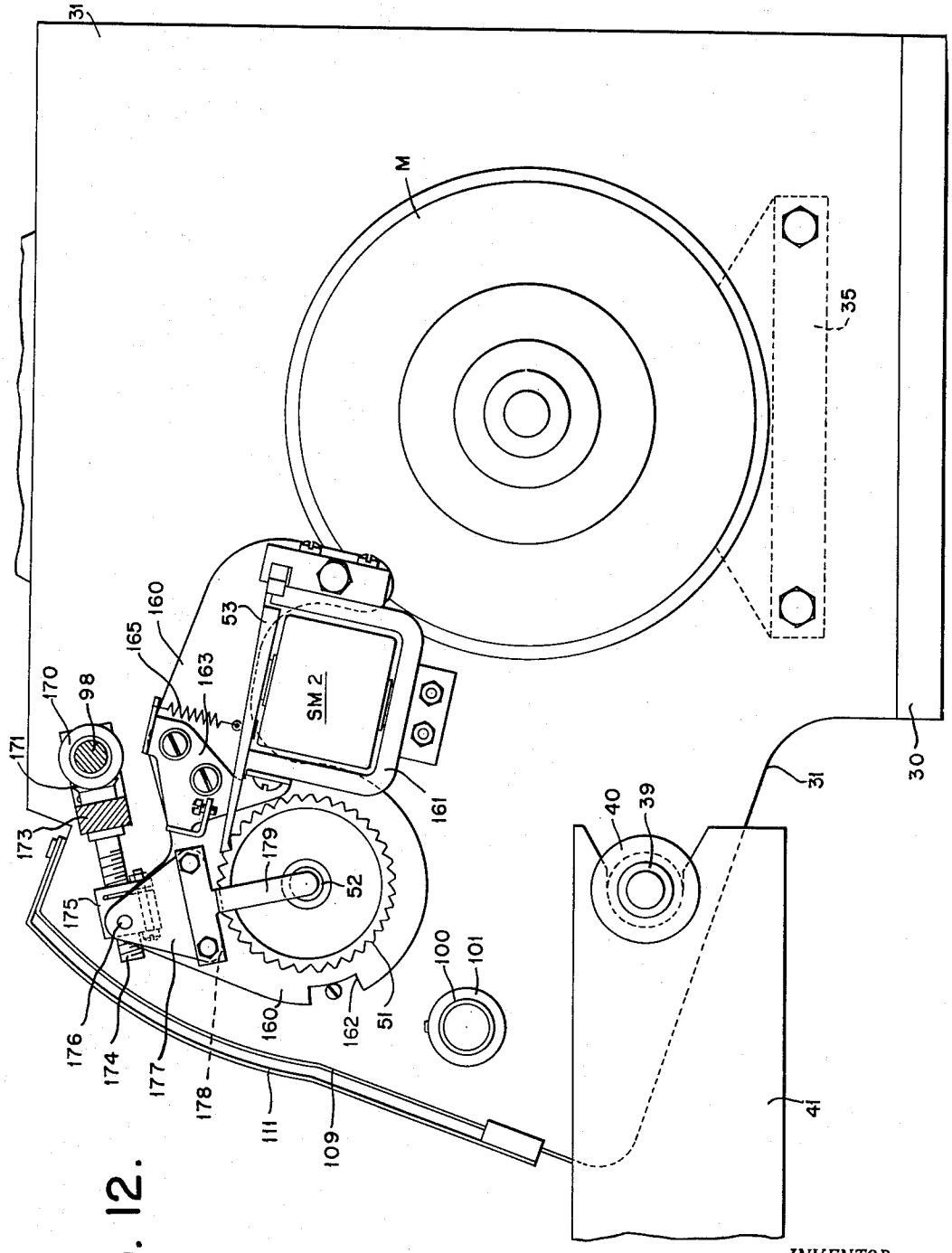



FIG. 12.

INVENTOR.
J. M. CUNNINGHAM
F.L.PRATT
P.M.KOVACH

BY

J W Armbruster

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 12

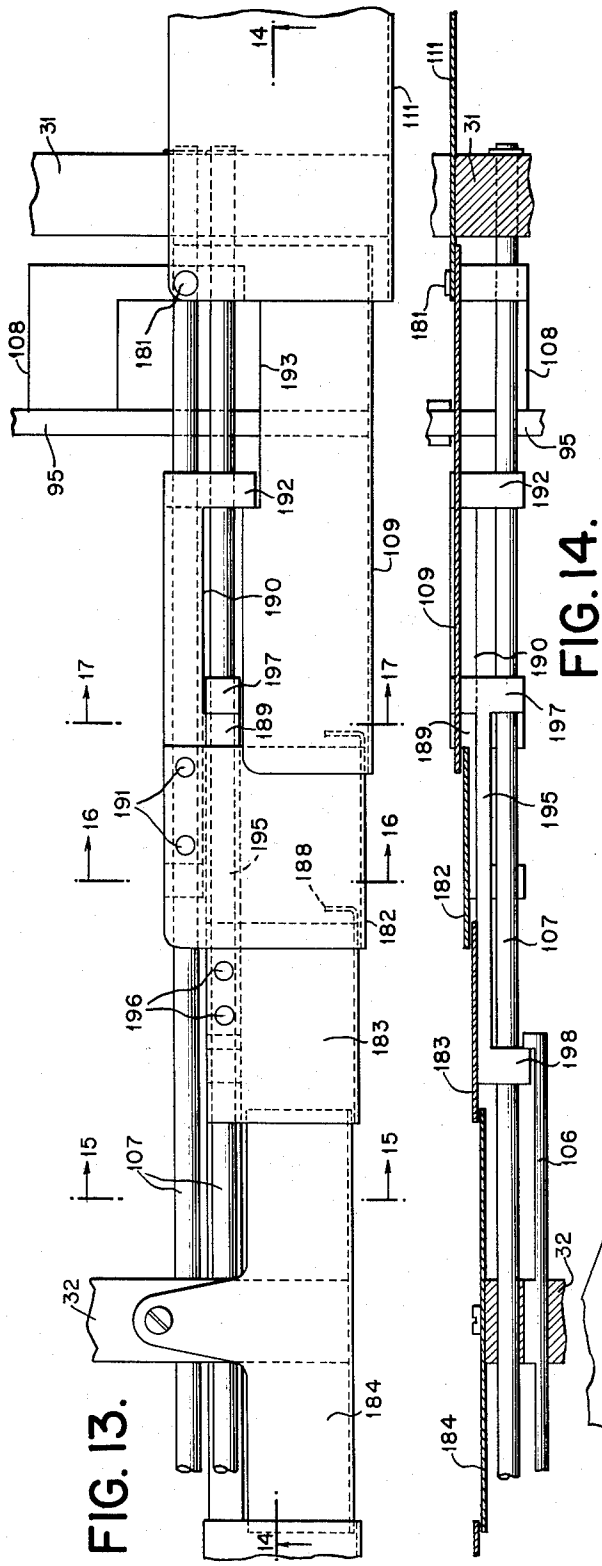


FIG. 13.



FIG. 14.

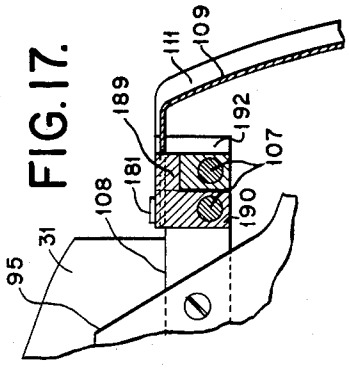


FIG. 17.

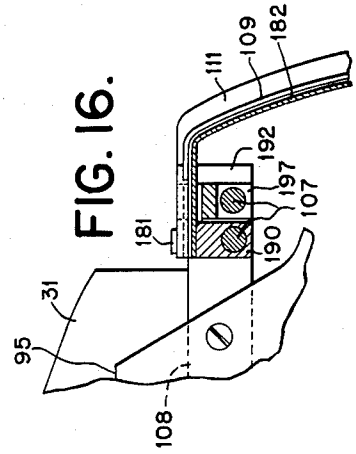


FIG. 16.

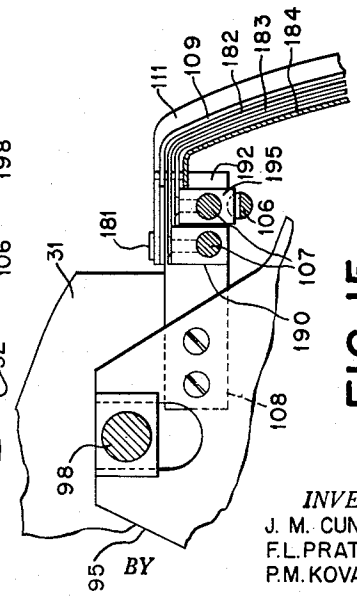


FIG. 15.

*INVENTOR.*
J. M. CUNNINGHAM
F.L. PRATT
P.M. KOVACH

BY

J W Armbruster

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 13

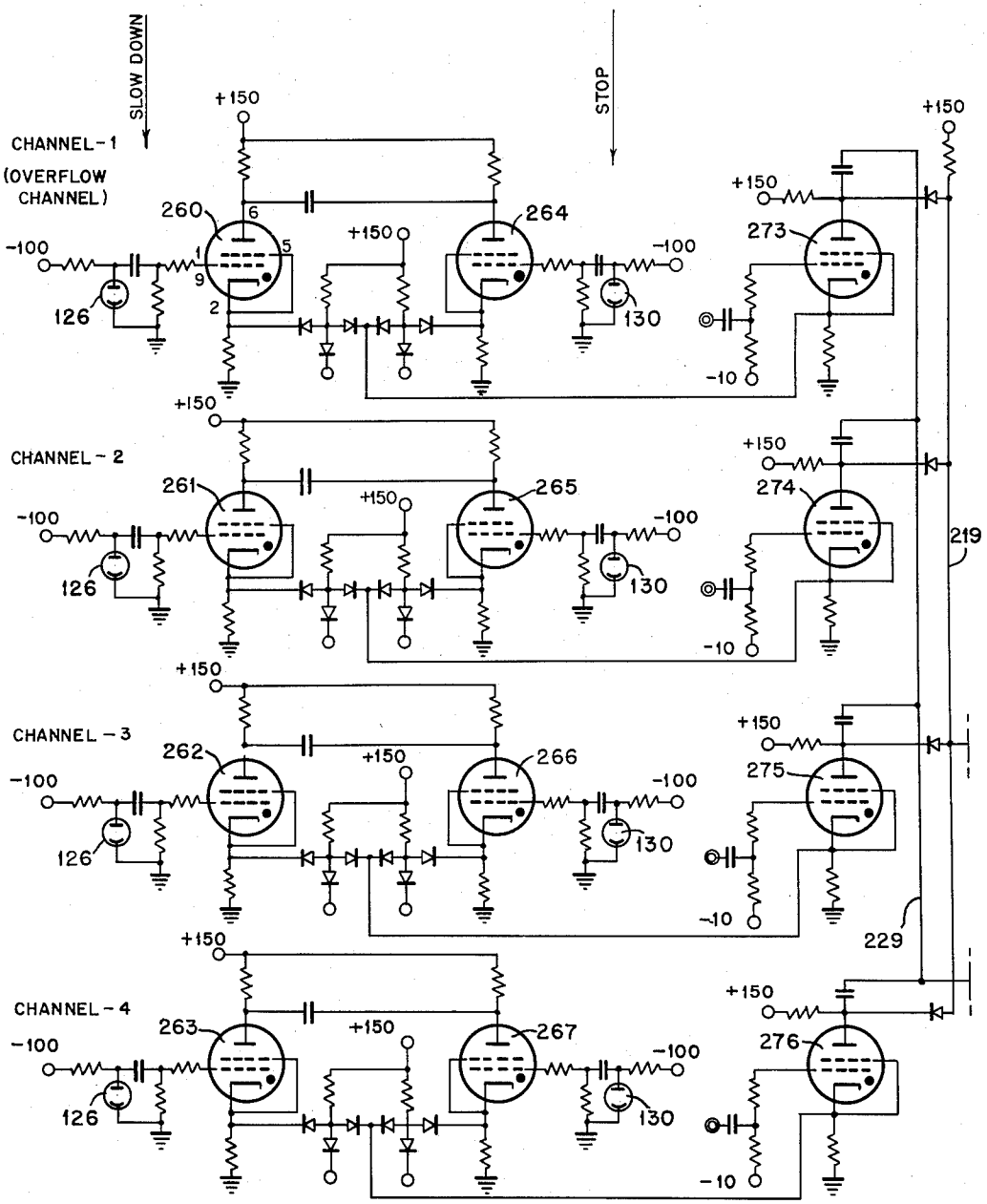



FIG. 19a

INVENTOR.
J. M. CUNNINGHAM
F. L. PRATT
P. M. KOVACH

BY

J W Ambrister
ATTORNEY

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 14

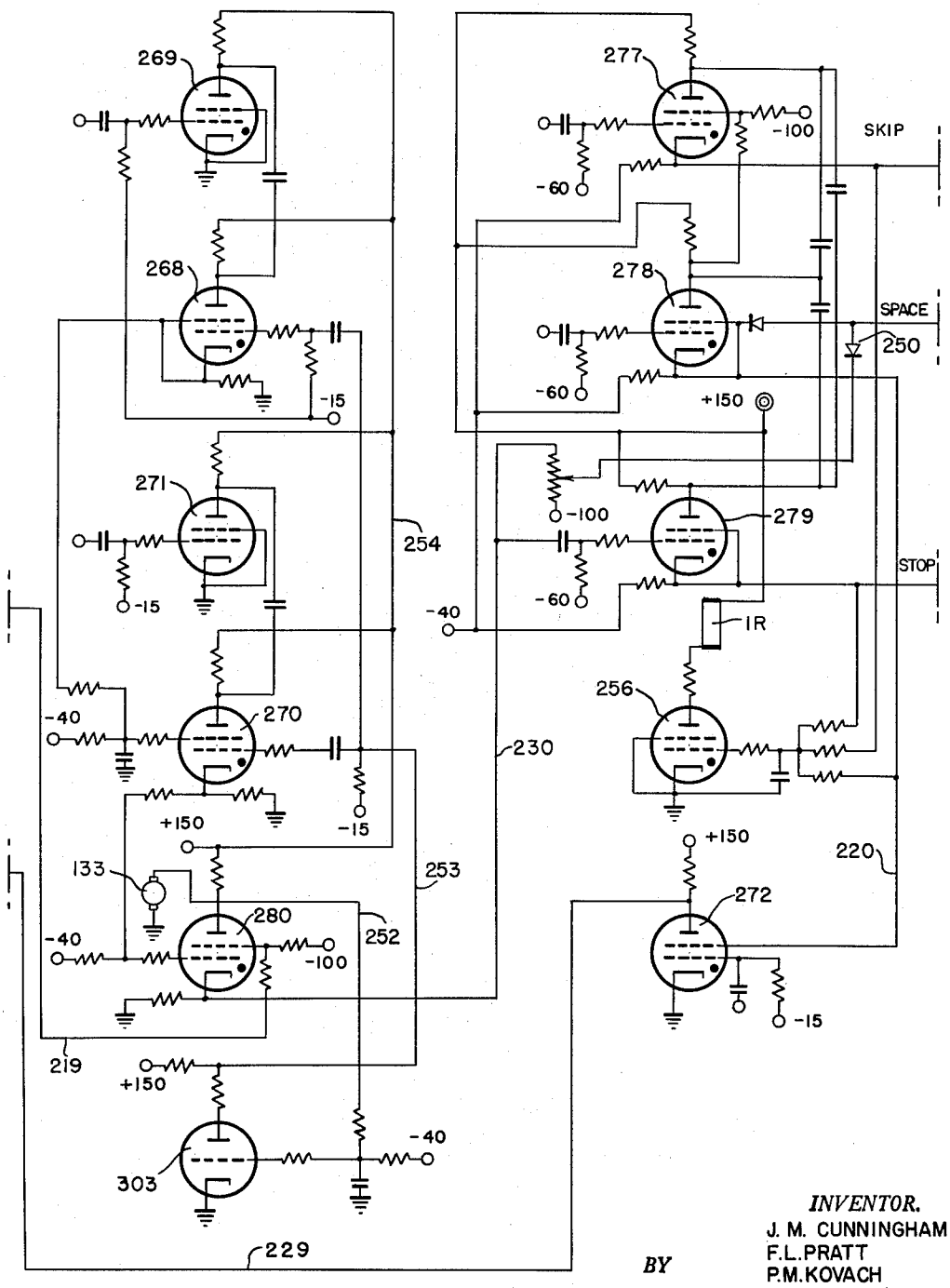



FIG. 19b

*INVENTOR.*
J. M. CUNNINGHAM
F. L. PRATT
P. M. KOVACH

*BY*

J W Armbruster

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 15

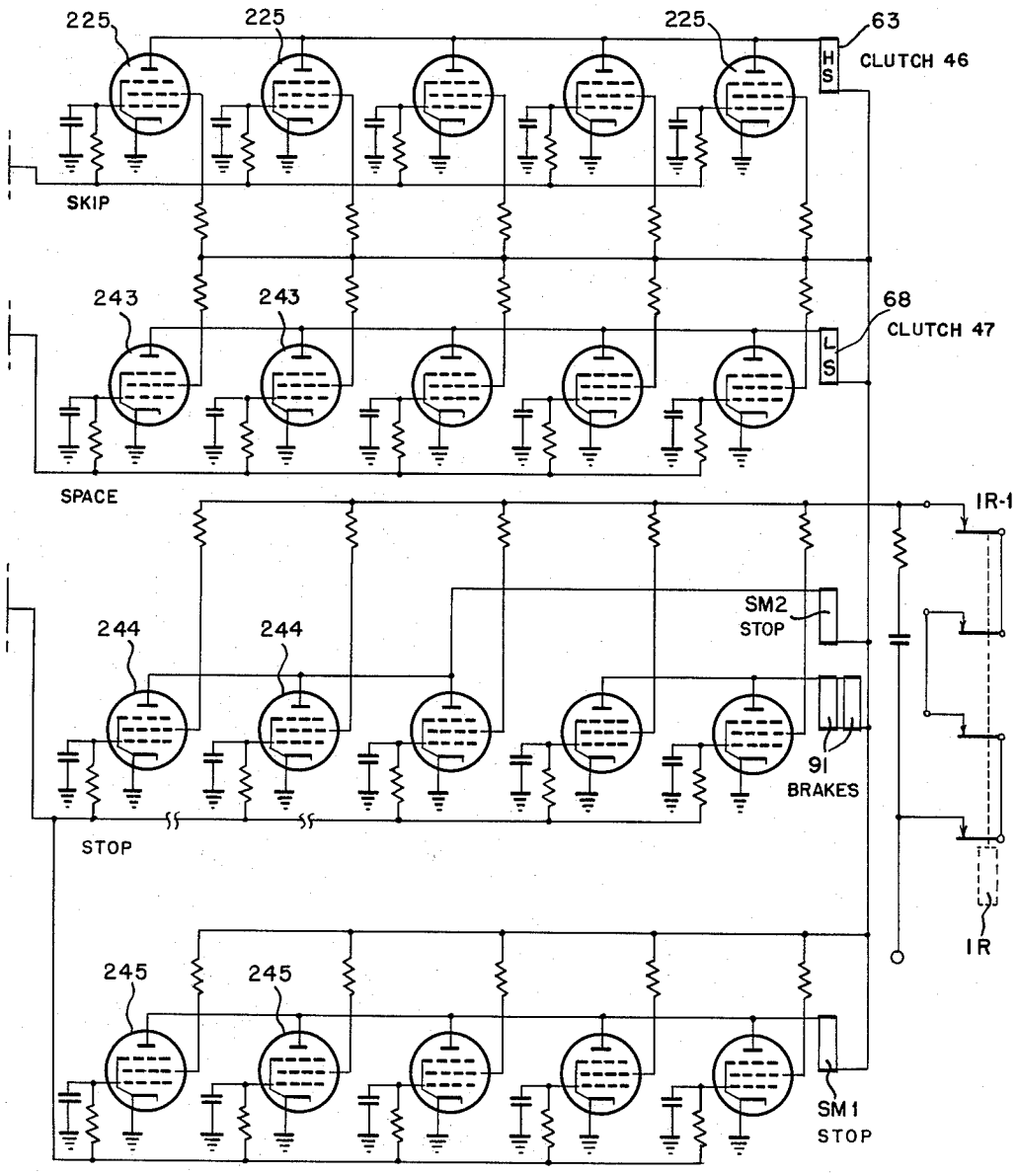



FIG. 19c

*INVENTOR.*
J. M. CUNNINGHAM
F. L. PRATT
P. M. KOVACH

*BY*

J W Chambers

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 16

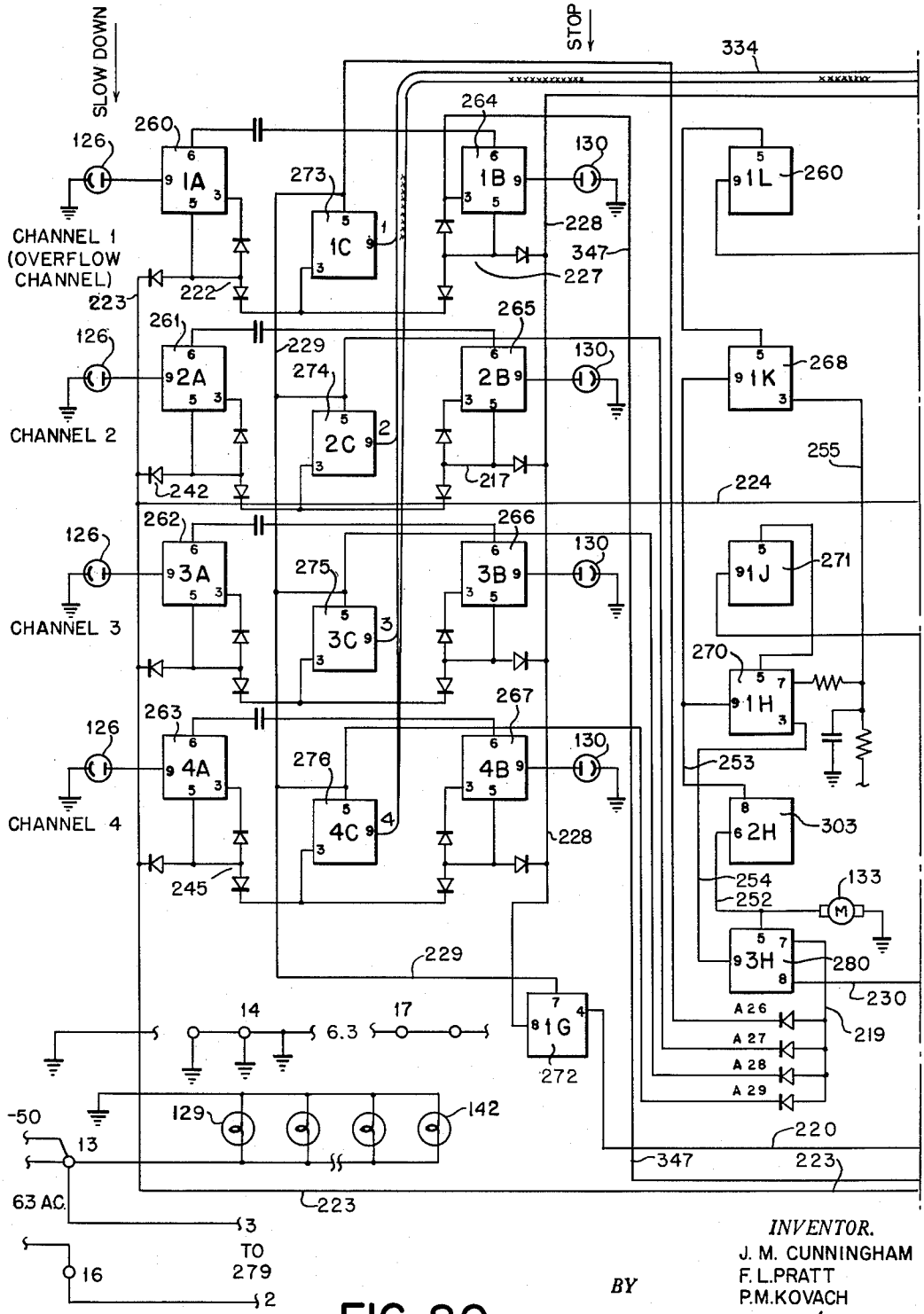



FIG. 20a

INVENTOR.
J. M. CUNNINGHAM
F. L. PRATT
P. M. KOVACH

BY

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 17

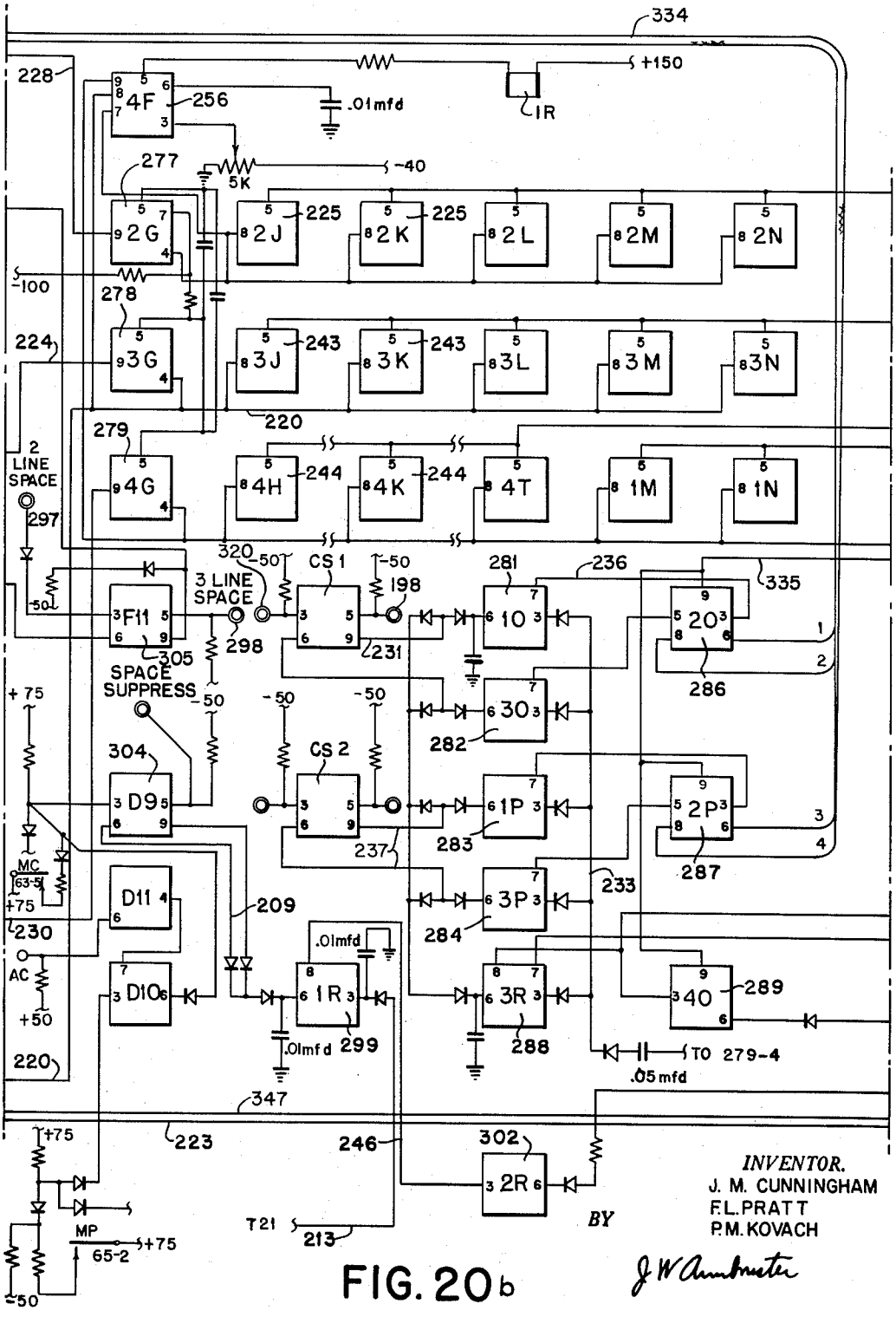



FIG. 20b

INVENTOR.
J. M. CUNNINGHAM
F.L. PRATT
P.M. KOVACH

BY

J W Armbruster

May 29, 1956 J. M. CUNNINGHAM ET AL 2,747,717

PAPER FEEDING DEVICE

Filed Dec. 23, 1954 18 Sheets-Sheet 18

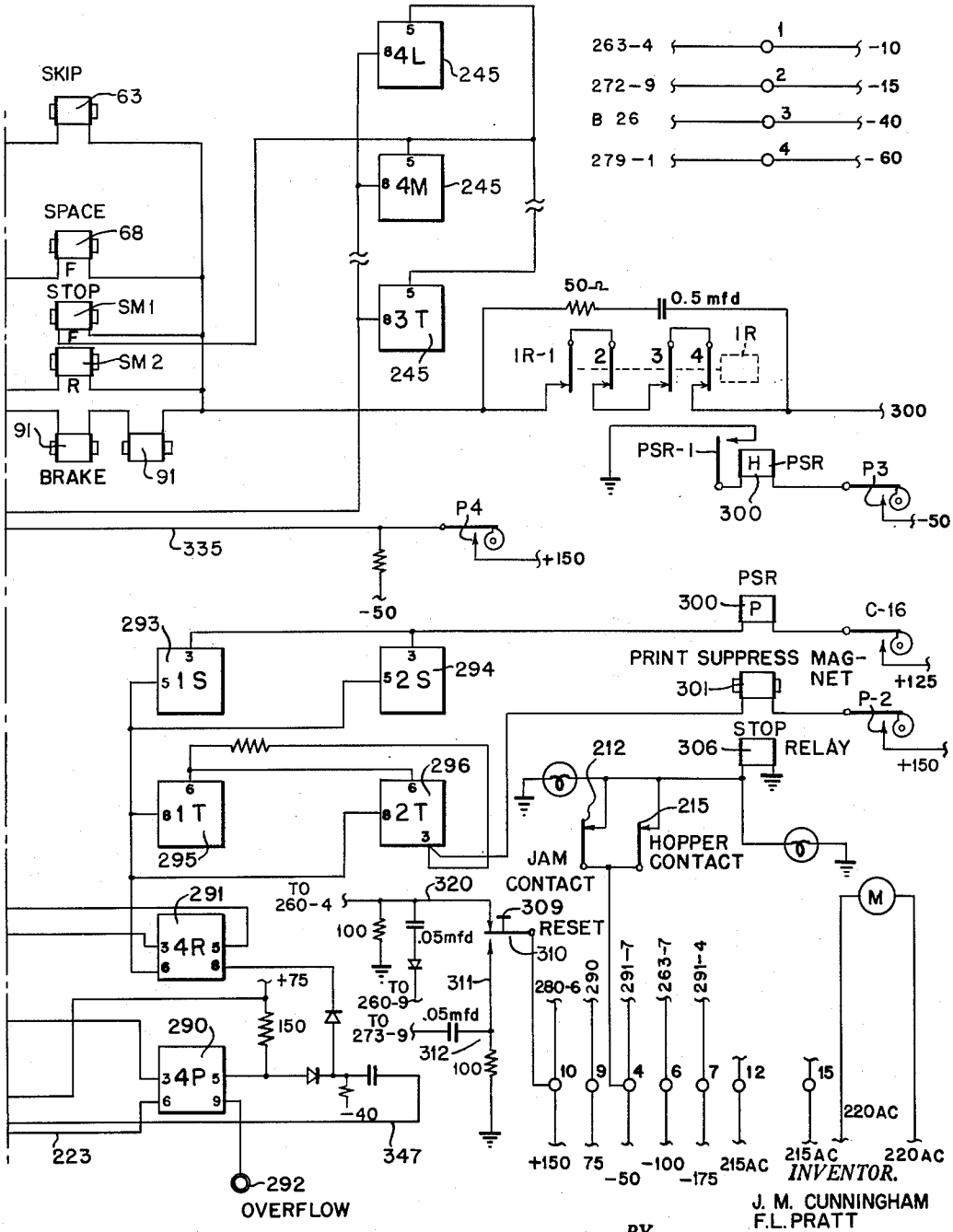



FIG. 20c

INVENTOR.
J. M. CUNNINGHAM
F. L. PRATT
P. M. KOVACH

BY

J W Armbruster

United States Patent Office 2,747,717 Patented May 29, 1956



2,747,717

# PAPER FEEDING DEVICE

James M. Cunningham, Endicott, Francis L. Pratt, Endwell, and Paul M. Kovach, Vestal, N. Y., assignors to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application December 23, 1954, Serial No. 477,286

29 Claims. (Cl. 197—133)

This invention relates generally to paper feeding devices and more particularly to form feeding means for operating at high speed with a record controlled printing machine.

Heretofore, when printers were used employing type bars and type wheels there was a relatively low limit to the speed at which such parts could be adjusted to print line after line. Then the paper feeding devices cooperating with such printers could very easily keep up with the pace of the printing speed. Now, with the advent of high speed printers such as wire printers and electrical, electronic or photographic recording devices it is necessary to provide record feeding devices to cope with recording speeds of 1000 or more lines per minute.

Therefore, it is an object of the invention to provide a paper feeding means of low inertia so that more rapid starting and advance movements and abrupt stops are made possible in order to attain greater speeds of record form spacing in synchronism with printing.

Another object of the invention is to provide improved means for performing line spacing of single, double and triple spaces, also long feeding means for short skip and long skip operations to predetermined heading and item positions on successive forms, and overflow control means to perform where the number of items requires more than one form for a complete related listing of a group. A perforated feed control tape, photocells and electronic circuits controlled thereby, govern the operation of the long feeding means for skip and overflow operations. The line spacing means is controlled by an electronic line space counter and coordinated with the operations of a high speed printer. Synchronism is maintained between the movement of the feed control tape and the advance of the forms.

Another object of the invention is the provision of an advanced form of low inertia feeding means for handling records of the multiple ply continuous form variety having marginal feed control perforations. The forms are transported by a pair of light weight nonmetallic pin studded belts which are driven through magnetic clutches and stopped by magnetic brakes. A detenting means for a more positive stop is also provided to accurately position the forms in predetermined print receiving positions.

Another object of the invention is the provision of improved means for advancing continuous form material under control of a tape with a plurality of stop control photocells for controlling movement of the tape and forms with changeable speeds for acceleration and deceleration to attain high speed without tearing the forms.

The invention is illustrated as an improvement over tape controlled feed devices of the kind shown in the Mills et al. Patent No. 2,531,885, issued on November 28, 1950. It is intended that the feeding devices perform in cooperation with high speed printing machines such as wire printing devices operable on the order of 1500 lines per minute.

Another object of the invention is the design of the feed device to be more or less independent and act as an auxiliary attachment suited for cooperation with any electrically controlled high speed printer. The feed devices are quite self-sufficient with a separate motor drive, clutches, control cam contacts, photoelectric tape sensing means and electronic circuit controls between the tape sensing means and the clutches. The feeding devices are designed for coordination with printing devices such as those of a record controlled tabulator by connection through an electrical cable for timing with the printing cycle so that printing and feeding operations fall in the proper sequence.



Another object of the invention is the provision of improved tape feed controls involving pairs of photoelectric sensing devices for controlling magnetic clutches to determine the starting and stopping operations in the feeding device. The control tape is provided with an indicium for each stopping control which is sensed twice photoelectrically to predict and predetermine the print receiving positions of the record form synchronized therewith. By an early photoelectric sensing of an indication of a desired print position, it is possible to achieve changeover or "slowdown" from the high speed drive to the lower speed and therefore obtain a more harmonic deceleration.

When the feed devices are stopped there is a sequence of controls falling in regular order involving first a switch from the high speed to the low speed clutches; second, the application of a magnetic brake; third, the deenergization of the low speed clutch and fourth, the engagement of a semi-positive mechanical stop for determining an accurate position. The foregoing controls are called into operation electronically and successively by the feed control perforation in the tape in conjunction with a long feed operation sometimes termed a skip operation. Ordinary spacing operations of one or several line spaces are usually caused by demands brought about in the printing tabulator and communicated via electronic controls to the low speed clutch devices.

Another object of the invention is to provide an improved form of counting control for the line spacing devices. A counter is ordinarily filled so that each entry thereto yields an overflow or carry operation to cause single line spacing. By subtracting one or two units of the counter content prior to spacing, it is possible to cause double or triple spacing operation because concomitant therewith the unit entry accompanying spacing does not immediately fill the counter but merely replaces the unit or units subtracted. After two or three spacing operations and related counter operation, a carry is caused to stop the spacing.

With the counter normally holding the value 2 and connected to emit a pulse for any further unit entry, each spacing unit entry creates a pulse and control to limit the operation to single line spacing. Reduction of the counter content to 1 or 0 prior to spacing then causes the requirement of double or triple pulsing along with similar spacing before the counter overflow signals for spacing termination. The counter is of a modulo 2 electronic form comprising two stages of trigger tube sets and a transfer tube to sense a carry pulse therefrom. The printer pulses said counter to change the status selectively of one or both trigger sets to reduce the value representation to 1 or 0, whereby one, two or three spacing operations are performed according to whether the values zero, one or two are previously subtracted from the counter.

Another object of the invention is the provision of electronic controls between a feed control tape and continuous record feed devices comprising controls for resetting, line spacing, multiple line spacing, long feeding, form overflow skipping, speed regulating, braking and detent stopping. Electronic interlocks are also pro-

vided to insure the absence of conflict between the controls. For example, the electronic controls for spacing, skipping and stopping are wired so that only one of the three is controlling at any one time.

Another object of the invention is the provision of a novel form of record material supporting device interspersed between the adjustable feed bands. These shields or paper table supports are of a telescoping character and comprise a series of nested plates which are shifted and extended relative to each other along with the adjustment movement of the pair of pin feed bands closer together or further separated to accommodate continuous forms of various widths.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of examples, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a perspective view showing the form feeding device assembly at the left of a cooperating printing tabulator;

Fig. 2 is a front elevation view showing the pin feed devices and the sheet guides surrounding the feeding means;

Fig. 3 is a sectional detailed view taken along line **3—3** in Fig. 2 and showing the sheet retainer for holding the forms on the feed pins;

Fig. 4 is a front elevation view with the sheet guides cut low to show the pair of feeding bands or pin feed belts and the adjustment therefor and also the clutches and brakes cooperating therewith;

Fig. 5 is a plan view showing the motor drive and connections to the pair of clutches, the feed belt and the control tape;

Fig. 6 is a sectional elevation view taken along line **6—6** in Fig. 5 and showing the motor drive and belt connections to the clutches;

Fig. 7 is a sectional elevation view taken along line **7—7** in Fig. 5 and through the main drive shaft upon which the control tape fed drum is mounted and synchronized with the drive to the pair of feed bands. This view also illustrates one of the magnetic brakes for aiding in stopping the rapidly moving feed devices in a predetermined position;

Fig. 8 is a sectional elevation view also taken through the main drive shaft but along line **8—8** in Fig. 5 and illustrating the pair of high and low speed magnetic clutches for driving the feed control belts;

Fig. 9 is another sectional elevation view taken through the main drive shaft but along line **9—9** in Fig. 5 and showing the brake and stop ratchet wheel at the right end of the apparatus.

At this point it may be noted that when Figs. 7, 8 and 9 are placed in a left to right order they represent a complete showing of a section through the main operating parts of the feeding devices;

Fig. 10 is a side elevation view taken along line **10—10** in Fig. 5 and showing one of the pin feed belts, the cooperating drive pulley for moving it, and the adjustable idler pulley for holding it taut;

Fig. 11 is a left side elevation view partly in section and showing the feed control tape supporting means and the spaced photoelectric sensing devices for reacting as influenced by light passing through feed control perforations appearing in the control tape as it is moved in synchronism with the advance of the record material;

Fig. 12 is a right side elevation view showing the stopping pawl and notched wheel construction for determining the accurate positioning of the form feeding devices;

Fig. 13 is a plan view of a portion of the sheet guides to show the nested arrangement of the guides for telescoping action when the feed bands are shifted for adjustment;

Fig. 14 is a sectional view of the sheet guides taken along the line **14—14** in Fig. 13;

Fig. 15 is a sectional detail view of the sheet guides taken along the line **15—15** in Fig. 13;

Fig. 16 is another section detail view of the sheet guides taken along the line **16—16** in Fig. 13;

Fig. 17 is still another sectional detail view of the sheet guides taken along the line **17—17** in Fig. 13;

Fig. 18 found on the sheet with Fig. 10 is a sectional detail view taken along the line **18—18** in Fig. 10 and showing the idler pulley construction for guiding the pin feed belt;

Figs. 19*a*–19*c* are electrical diagrams showing the electronic devices cooperating with the photoelectric tape sensing controls for determining the mode of control by the tape over the feed devices;

Figs. 20*a*–20*c* when taken together form an electrical diagram showing the electronic controls of Figs. 19*a*–19*c* in a more general way and as they are coordinated with the line spacing and printer controls.

The invention is illustrated in connection with a machine for advancing continuous record forms at a rapid rate. In order to keep pace with the high speed printer, it is necessary that the feed device not only be capable of moving the forms rapidly from line to line and with long feed movements, but also be capable of rather abrupt stops and rapidly accelerating starting operation. As an aid to this type of control the moving parts are made to have low inertia and because of the light weight of the non-metallic belts there is less shock and better adaptability for acceleration than with purely metallic construction.

Another aid to the speed of operation is the use of magnetic clutches and brakes and rapid electronic response to feed tape control.

In Fig. 1 it is seen that the feed control device **20** comprises a large frame having four columns **21** which support the encased operating controls **22** at the upper righthand section and branching therefrom are the rearwardly extending and descending guides **23** which carry the cascading printed forms downward into a receiving hopper **24**. The magazine for the fanfolded continuous forms is situated centrally at **25** and from there the forms are drawn upward in front of the platen in the printer and then further upward and caught around the pin feed belts opposite the printing devices which are encased in the frame **26**. Base **27** is mounted on wheels for easy movement of the feed devices into position against the printer.

It will be noted that there is a dividing line between the outer case of the printer and the case of the feed control devices and thus it is clear that they are separable and the feed devices are independent and suited for assembly to other printing mechanisms. When they are brought together they are clamped in place and electrical cable connections are established so that operations are coordinated and printing is interspersed with operations of the feed device.

The interior framework construction of the feed head is best shown in Figs. 4 and 5 where it is seen that the frame comprises a base member **30** which supports three main upright frames, a right side frame **31**, a center frame **32** and a left side frame **33**. A pair of cross members or spacer frames **34** and **35** are provided between the main frames. Upon the horizontal one **35** of the latter rests the drive motor M.

As an adjustable form of connection to the printer, the center frame **32**, Fig. 8, holds a large threaded nut **38** through which passes a centrally threaded tube **39**, Fig. 4, which has at its ends a pair of spool shaped receivers **40** into which are hooked extensions of the printer frames **41** and **42**. The printer may be of the form of the high speed wire printer disclosed in Patent 2,730,040, issued January 10, 1956, and filed on November 8, 1951, by R. B. Johnson. The threaded tube **39** is turned by a hand

crank which fits into the end of the tube, and as it is turned the nut 38 moves the feed head axially a maximum of about two inches in either direction.

After the leading end of the continuous forms has been threaded through the printer and onto the pin studded belts of the feed unit, the card feeding and sensing devices of the tabulator are started to control the printer. With the wire printing devices set up from a card, the platen drives the forms layers against the print heads. After recording is effected the feed devices advance the forms one line space or several spaces as determined by the control circuits set up within the printer, or if a control channel of the feed control tape has been selected (also by the printer as a result of a group change, total print, etc.) a long spacing or skip operation may be performed by the carriage. In the latter case, the forms are advanced until the perforation of the selected tape channel signals for the slow down and the stop at which time the electronic circuits of the carriage call for application of the brakes and stops to stop the forms in position for receiving the next line of print at the predetermined line on the forms.

The feeding devices have but few parts of light weight; all unnecessary bulk is eliminated. An electric motor drives toothed fiber or rubber belts which in turn drive constantly turning clutch wheels containing the clutch magnets. When a clutch magnet is energized, the comparatively light-weight clutch drive plate is attracted to the magnet, and the drive shaft to which it is attached is caused to revolve. A driving key transmits the motion to a pair of laterally adjustable drive sprockets. Assembled on the sprockets are toothed belts also nonmetallic and studded with regularly spaced series of forms feed pins which engage in the marginal holes along both edges of the form material.

A general understanding of the arrangement of the feeding control parts may be gathered with reference to the front elevation view, Fig. 4. There it is seen that the pin studded feed belts 44 and 45 are spaced within the unit and are driven by a high speed skip clutch 46 or a slow speed spacing clutch 47. When stopping control is called for there are called into action, the left magnetic brake 48 and a similar brake 49 at the right. The definite stopping position is determined by a pair of toothed wheels 50 and 51 near the ends of the feed drive shaft 52 and cooperating with similar pawl levers 53, Fig. 5. Space feeding and skipping are usually initiated by the printer, but overflow skipping control and all stopping controls are exercised by a feed control tape TP which is driven by a pin wheel 54 fastened to the left end of the drive shaft 52.

Returning to consideration of the driving connections, it is noted in Fig. 6 that on a motor shaft 56 is an outer pulley 57 with a drive belt 58 looped to the right around the constantly moving portion of the high speed clutch 46.

The inner motor pulley drives a vertical belt 59 which rotates a speed reducing idler pulley 60 which is assembled with a smaller pulley 61 having drive connections through a belt 62 to the low speed clutch 47.

All these belts and pulleys as well as the pin feed belts are seen to be of the non slip toothed type of belting known as Gilmer belting.

The idler pulleys 60 and 61 are supported on bearings in a fork shaped bracket 64 (Fig. 4) adjustably secured to the center plate 32.

In Fig. 8 it is noted that the interior construction of the two magnetic drive clutches 46 and 47 is similar so that a description of one applies as well to the other. The slow speed space clutch 47 is driven to move the paper forms at the rate of twenty-five inches per second and the other high speed skip clutch 46 has direct belting to drive it four times as fast to move the forms at the rate of one hundred inches per second. They are both rotatably mounted on the drive shaft 52 which is supported by bearings in the side frames and also supported by a ball bearing 66 in the center frame 32. The clutch 47 at the right has a rotatable armature core 67 which holds a ring coil 68 between it and an inner core ring 69. A ball bearing 70 is clamped between the core pieces and allows the coil and core to rotate freely on shaft 52. The periphery of core 67 is circular and formed with teeth 71 for engaging with the inner recesses of the drive belt 62. The lead wires of the clutch coil 68 extend through core 67 and are attached to insulated slip rings 72 and 73 assembled within annular grooves of a plastic ring 74 fastened to the core. Cooperating with the slip rings are contact brushes 75 which extend from spring containers seated in an insulation ring 76 fastened to the center frame 32 and provided with terminal lugs 77.

Adjacent to the right hand faces of the core pieces 67 and 69 is the normally stationary clutch drive ring or disk 78 which is of annular formation with an arch shaped cross section. Onto the flat faces of disk 78 there is bonded a layer of brake lining material 79 which serves to frictionally engage the disk with the core when the magnet coil 68 is energized. A thin spring plate 80 is riveted at 81 to the drive disk 78 and to the plate there is riveted a driving arm 82 pinned to shaft 52 and carrying one end of the drive key bar 83, Fig. 10, which extends through the adjustable drive sprocket 84 carrying the feed belt 45. Plate 80, Fig. 8, is circular and held to disk 78 with the rivets 81 around its rim; and near its center it is secured to the arm 82 to provide a positive drive circumferentially, but the plate has a free annular area of flexure axially. The moving clutch core assembly 67, 68 and 69 is mounted close to the drive disk 78 so that a minimum of axial disk movement to the left causes a locking contact between the clutch disk and the magnet armature cores due to the magnetic attraction created by the coil 68. The required axial movement of disk 78 is obtained by flexing the spring plate 80 of the driven assembly.

As already pointed out, the high speed clutch 46 at the left, Fig. 8, has all the clutch parts and contact brushes, etc., as duplicates of the parts described in connection with the clutch 47 at the right. It also has connection to a driving arm 85 and a key bar 86 similar to the arm 82 and key 83 of clutch 47. In Fig. 4 it is seen that key 83 is connected between arm 82 and a similar arm 87 connected to the brake 49 on the right frame 31, and key 86 is connected between arm 85 and a similar arm 88 connected to the brake 48 on the left side frame 33. Since all four arms are pinned on shaft 52 the arms and keys 83 and 86 rotate as a unit to drive belts 44 and 45 whenever either clutch is energized and the whole assembly is retarded by the action of both brakes 48 and 49 working together near the opposite ends of shaft 52.

Since the magnetic brakes are similar in construction (see Figs. 7 and 9) it will suffice to describe the one of them shown on the right frame 31 in Fig. 9. They are of the same interior construction as the magnetic clutches already described, with the difference being that the cores 89, 90 and ring coil 91 of the brake are not movable but are bolted to frame 31 by bolts 92. It is the disk 93 of the brake which is the movable part because it is riveted to the thin plate 94 which in turn is fastened to arm 87 fixed to shaft 52 and carrying key 83. Whenever either magnetic clutch is energized, the connected shaft 52, arm 87, plate 94 and disk 93 will rotate along with the sprockets for the feed belts and move the left part of the magnetic brake.

When the brake coil 91 is energized (usually on a signal from the control tape that a stopping position is approaching) the brake disk 93 is attracted to the cores 89 and 90 of the stationary brake assembly. The spring plate 94 flexes to permit the slight axial movement towards the right necessary to clamp the disk and fixed core together and retard shaft 52 on the right end while the other brake is doing the same thing at the left. The brakes do not determine the exact and final stopping position which is arrived at precisely through a pawl and

toothed wheel arrangement, but the brakes do have decelerating and anti-rebound effects which make possible the sudden changes from high speed feeding to quick stop positioning.

Before going into detail about how the two key bars 83 and 86, Fig. 4, drive the feed belt sprockets, it may be well to point out that the feed devices are mounted on the two movable sprocket carrier plates **94** and **95** which have guiding and adjusting means for setting the feed belts to take continuous forms of various widths.

In Figs. 9 and 10 it is noted that the carrier plate **95** is hollowed out to encircle the shaft **52** and sprocket **84** and it is notched at **96** on the top to connect to a sliding block **97** which is loose on a shaft **98**. Near the center of plate **95** there is secured a flanged tube **99** which extends beyond both faces of the plate and fits loosely on a tube **100** which extends across the entire feed unit and has pairs of pinned collars **101** adjacent all three frames **31**, **32** and **33** for holding it in position.

Adjacent to the guiding tube **100** there extends across the entire unit a threaded shaft **103**, Fig. 4, which is suspended in and borne by a bearing passing through the center frame member **32**. It is held in position by a pair of pinned collars **104** and is formed with differently threaded sections, a righthand thread on the side passing through the righthand carrier plate **95** and a lefthand thread extending across the left end and passing through a threaded nut secured to the carrier plate **94**. Near the left end, shaft **103** is provided with an extending pin on to which a notched handle may be assembled as projected through the left side frame **33** and then the operator may rotate the handle to turn the threaded sections so that the sprocket carrier plates **94** and **95** are drawn closer together or extended further apart in conformity with the spacing of the marginal lines of feed perforations found in the continuous forms. There is a nut such as nut **105**, Fig. 10, secured to each of the carrier plates so that movement of the screw is communicated to the plates.

As the carrier plates are moved back and forth they carry along with them a series of telescoping sheet guides. These guides are arranged to cover all the space between the carrier plates so that the continuous forms are supported in the gap between the pin feed belts. The outer ones of these telescoping sheet guides are secured directly to the carrier plates and the others are either centrally secured or suspended on a pair of rods **107** noted near the top of Fig. 10. In this same figure it is also seen that rods **107** pass through a block **108** secured to the outer face of the carrier plate **95** and attached to block **108** is the outer one of the sheet guides **109** which extends all the way down and around the bottom of the carrier plate **95** where it is secured at **110** to the lower surface of the plate.

A more detailed explanation of the sheet guides is given hereinafter.

Returning to consideration of how the pin feed belts are carried by the carrying plates it will be noted in the sectional view, Fig. 9, that the carrier plate **95** is formed with a large circular opening around the shaft **52** and into this opening there is secured a large circular member **112** which is formed with an inner circular groove **113** which acts as a raceway for a series of ball bearing rollers **114** extending inwardly from the side of the large sprocket wheel **84**. In Fig. 10 it is seen that there are three such rollers **114** equally spaced within the center opening of the sprocket wheel and they serve to form an easy running guide for the feed belt **45** and do so with the elimination of the usual heavy hub and therefore contribute to the low inertia characteristics of the drive.

Also secured to the inner wall of the sprocket wheel **84** is a notched key plate **115** which embraces the sides of the key bar **83**. In this way the sprocket wheel, in any of the lateral positions, partakes of the circumferential movement of the magnetic clutch drive through the laterally extending kay bar **83**.

The outer periphery of sprocket wheel **84** is formed with flanges to confine the feed belt **45** and the periphery is formed with teeth **116** to fit into the positive drive construction of the feed belt of the Gilmer type. The outside of this belt **45** is studded with a regular series of feed pins **117** which are pointed for easier penetration into the marginal feed openings prearranged in the multiple plies of the continuous record forms.

Although the feed belt **45** is driven by the large upper sprocket **84** it is guided and supported at the proper angle by a small adjustable sprocket wheel **119** at the lower end of the loop. The details of construction and assembly of this small idler sprocket are shown in Fig. 18 on the same sheet with Fig. 10. There it is seen that a large screw bolt **120** passes through a slot in carrier plate **95** and is secured in position by a pair of nuts **121** adjacent both faces of the plate. Loosely mounted on bolt **120** by means of a ball bearing **122** there is a hub of the sprocket **119** which is therefore free rotatably and positioned to hold the lower end of the feed belt **45** taut and at the proper angle with respect to the sheet guides so that the continuous forms are advanced upwardly and towards the rear as governed by the driving action of the large upper sprocket wheels.

Although the description of the feed sprockets and carrier plates has been directed primarily to Figs. 9 and 10 with reference to the righthand carrier plate **95** and the sprockets and feed belt thereon, it will be realized that the other feeding arrangement, Figs. 4 and 7, showing the feed belt **44** with the sprockets **124** and **125** on the left carrier plate **94** are similar in construction and the description given hereinbefore applied as well to the feeding means at the left as well as to the feeding means at the right.

A number of things determine the starting and stopping of the feed belts to advance and position the continuous forms. It is already noted that the magnetic clutches when they engage serve to operate the main feed shaft **52** to advance the sprocket wheels, and the brakes at the sides of the unit contribute toward the stopping effect on the mechanism. Now it will be noted that there are a few other instrumentalities for governing the starting and stopping actions of the sprocket wheels. There is some showing of these other controls at the left end of shaft **52** as shown in Fig. 7. There it is noted that on the extreme left end of shaft **52** there is pinned a rather large wheel provided with a continuous series of extending pins **127** which engage the control tape TP shown in Figs. 5 and 11 as passing around wheel **54** and forming a rearwardly extending loop held taut over a guide **128** which is adjustable to hold the tape taut and at the same time keep the lower leg of the loop in a horizontal position to pass between pairs of light emitting bulbs **129**, **142** and pairs of photocells **126**, **130** assembled on opposite sides of the path of the tape.

In Fig. 5 it is seen that the tape TP is formed with the center line of perforations to cooperate with pins **127** for feeding purposes and that it has four other longitudinal channels marked to represent positions wherein feed control perforations such as **131** may be cut so that the tape is prearranged to provide predetermined stopping positions. These stopping positions usually coincide with the first line of one or more headings, the first line of a set of items and the first line of one or more total recording positions. It is the usual thing for the printing instrumentalities to initiate feeding; for example, after a total recording operation is finished in the printer a signal is given to the feeding devices and they operate and the tape is moved in synchronism therewith until the perforation appears representing the first line of the following heading on the following form. As the forms are advanced at high speed from the total line of one form to the beginning of the succeeding form the perforation

representing the beginning line appears at the first pair of photoelectric controls **126** and **129** and thereby signals for a slowdown of the feeding speed. Following this, the perforation goes on further to appear at the related pair of photocell devices **130**, **142**, to signal for a complete stop which is attained by application of the brakes and also by application of a positive pawl stop which is described hereinafter.

It was noted that three of the channels of the tape may be devoted to control for stopping at the first heading, first item and first total positions and now it may be noted that the fourth channel could be provided for overflow conditions and for such cases the tape controls initiation of the feeding operation as well as the stopping operation. As a series of items are recorded on a form and should said series of items be too numerous to be recorded on only one form, then there is a point reached near the bottom of the form where the controls should be effected to cause item recording to terminate on one form and have the forms advanced so that a resumption of item printing is carried on on the second form beyond the heading space of the second form. In order to do this, the control tape customarily has an overflow perforation which appears when recording approaches within one or a few line spaces from the bottom of a form. The particular photoelectric controls associated with the overflow tape channel then call into operation the magnetic clutches for a high speed advance from the end of one form to the first item recording line of the following form.

Before going on to describe the spacing control commutator **133**, Fig. 7, and the stop pawl mechanism cooperating with ratchet wheel **50** it is believed advisable at this point to describe briefly the means for supporting and adjusting the tape sensing photocell devices already noted. Extending from the outside of the left side frame **33** are a series of three large studs **134**, Figs. 7 and 11, onto which is fastened a small vertical frame member **135** which has extending therefrom an elongated bar **132**, Fig. 11, along which the adjustable guide **128** is moved and clamped to take feed tapes TP of various size. A tape length is equal to, or a multiple of, the length of a form in the continuous record. The frame member **135** extends forwardly and carries a pair of shouldered studs **136**. Guided by studs **136** is a rack **137** formed with a pair of slots engaging shoulders on said studs and onto the outside surface of rack **137** there is secured a pair of angle members, the upper one **138** of which extends horizontally under the tape path and is formed with eight openings **139** coinciding with the positions of the four pairs of lights and pairs of photocell devices corresponding to the four tape channels, the second lower angle member **140** serving to support the eight photocell tubes **126** and **130**. Extending upwardly from rack **137** is a plate **141** to which there is secured the pair of light holders **129** each of which contains four light bulbs **142** for supplying the illumination which is projected through the four pairs of openings **143**, to correspond with the photocell openings **139** in the plate under the tape TP while the holders **129** are assembled above the control tape.

In order to prevent the intrusion of daylight upon the photocells **126**, **130** there is secured to the lower part of plate **135**, underneath the light emitting holders **129** a box **143** which is attached at **144** and **145** to the outer face of plate **135** and formed to completely enclose the photocells with the exception of the top of plate **138** which is exposed but covered with the feed control tape and allows light to penetrate downward only in those instances when a feed control perforation passes directly over one of the openings **139**. There is a close fit between the top cover of box **143** and the top surface of angle piece **138** in all other positions to the side and rear of the center strip occupied by the width of the control tape TP.

The rearmost set of photocells **126**, Fig. 11, is separately mounted on a frame slide **146** which is adjustable along slot **128** in rack **137** and therefore movable relative to the front pairs of light bulbs and tubes **142**, **130**. This is done to provide a variable degree of "slow down" time which is usually about 5 or 6 line spaces in duration, but which, by means of the adjustment noted, may be extended over a much longer distance and a longer interval of time.

It is noted that this rack arrangement for holding the photoelectric sensing devices affords the possibility of horizontal adjustment back and forth so that if rack **137** is moved a slight extent one way or the other it carries with it all the light projecting means and also the photocell sensing means. In this way the position of the tape corresponding to a certain line position on the form may be varied to suit the pre-printed arrangement of blocks on the forms. Various forms may have different arrangements of heading space, item receiving spaces and total receiving spaces and in this way the device is adjustable so that variations may be had to take all these things into consideration.

Having described how the photocell devices are made adjustable we are about to continue to explain how the line space commutator control and the positive ratchet detent stop means are also adjustable and that a common adjusting means takes care of all three setting means with the one control knob.

In Fig. 7 it is noted that the small frame member **135** is provided with a bearing retainer **147** for holding a ball bearing **148** in position around the end of shaft **52** to support it and other members near the end of the shaft. One of such members supported is the sector **149** which is used for varying the position of the rack **137** already noted. Attached to sector **149** is a commutator wheel **133** provided with a complete series of commutator contact inserts **150** spaced all around the periphery of commutator **133** and corresponding to the line space positions of the forms held on the sprockets to which shaft **52** is connected. It is through the action of the sector **149** on the commutator wheel **133** that it is made adjustable relative to the tape adjusting sprocket **54** which is representative of the continuous form line position. Onto this large tape sprocket wheel **54** there is secured an arm **151** having an overhanging portion **152** to which there is attached a contact blade **153** having a downwardly projecting end which acts as a sensing brush in cooperation with the inserted contacts **150** of the commutator. Between the inserts **150** and blade **153** there is set up a series of intermittent contacts as the feed unit advances the record forms. As each line space on the form passes the printing line one of the inserts establishes a pulse conducting path through the blade **153**. These pulses are carried over to an electronic counter and this governs the number of line spaces allowed for each printing operation and controls whether item recording is to be singly, doubly or triply spaced.

It will be noted that the commutator wheel **133** is fixed with respect to the frame of the machine and is subject to slight variations in radial positioning to conform with similar adjustments made with respect to the stop pawl and the photocell sensing devices. In other words, the adjustable parts of the line counting pulse mechanism are the commutator and photocells which are shifted relative to the tape and the contact blade **153** assembled on the tape holding wheel **54**. The circular commutator wheel **133** is fixed to the bearing **147** loosely mounted on the shaft **52**, Fig. 7, and connected to the sector **149** by screws **156** so that when the sector **149** is rocked a slight amount for adjustment of the photocell sensing devices, the commutator is also rocked so that the contact inserts **150** thereon are carried along to the correct adjusted positions in conformity with the lines on the form.

The element which is the direct cause of the adjustment of the commutator and the photocell rack is a shouldered stud **157** which projects into a slot **158** cut into the upwardly extending arm formed as part of the sector **149**. This pin **157** is only one small part of an adjusting device

extending across the entire feed device to vary the positions of a pair of pawl carrying plates 159, 160, Fig. 4, loosely assembled on bearings adjacent to the main side frames 33 and 31 respectively and carrying the control means for the stop pawls 53 already mentioned. The best showing of one such carrying plate is the showing in Fig. 12 of plate 160 directly outside the righthand face of frame 31. There it is seen that the plate 160 is pivotally mounted on the shaft 52 and formed with the radial notch 162 for limiting its movement with respect to a fixed stop screw. There it is also noted that the plate 160 carries attached thereto a U-shaped frame 161 which is the mounting means and armature for the stop control magnet SM2 which is one of a pair duplicated near the opposite side frame. Pivotally mounted on said frame 161 and poised above the core of the magnet SM2 is the stop pawl 53 already mentioned as the positive locating means in cooperation with the toothed wheel 51 mounted fast on the shaft 52. Since the shaft 52 is also the holding means whereon the feed belt sprocket wheels are mounted, it will be realized that any stopping action imposed upon notched wheel 51 will also influence the final positioning of the feed belts and the continuous record material carried thereon.

At this point it is well to note the shape of the cooperating surfaces between the pointed end of pawl 53 and the notched formation of the stopping wheel 51. These teeth are not of a truly abrupt ratcheting type. The angle of engagement is rather impositive. In other words, in order to facilitate rapid starting conditions, the wheel is under certain circumstances adapted to cam out the pawl and move rapidly regardless of the temporary engagement of the pawl therewith. However, when the wheel is not under its own motive impulsion the action on pawl 52 by the magnet SM2 is strong enough to cause a definite and positive stopping action and such action is exercised when the drive of the magnetic clutches is relinquished and the energization of magnet SM2 is dominant. It is only under starting conditions whereupon even though magnet SM2 is deenergized the pawl persists in being attracted, that the magnetic clutches grasp shaft 52 and empower the notched wheel 51 to move immediately and cam out the end of pawl 53 in order that the rapid start may be made without hindrance.

For confining and controlling the action of pawl 53 there is mounted on plate 160 an extension piece 163 which is formed with a lug carrying an adjustable stop screw 164 which may be varied in position to have its end a selected distance above the top of pawl 53. Another extension on 163 is the terminal for a spring 165 tending to pull pawl 53 in a clockwise direction about its pivot at the right end and tending to disengage the pointed end of the pawl. However, when magnet SM2 is energized, the pawl is rocked counterclockwise against the tension of spring 165 and the pointed and cam-like wedge surfaces of pawl 53 are forced into the nearest notched opening in wheel 51 and the wheel is held thereby in a definite stop position which is related to a difinite printing line on the record form material.

Although partly obscured in Figs. 4 and 11 there is enough of plate 159 and the associated stop magnet SM1 and pawl 53 shown to reveal similarity to parts already described with relation to Fig. 12 which are duplicated at the left end of shaft 52. In Fig. 4 the two stop control wheels 50 and 51 are shown near the ends of shaft 52 and it will be realized that by being engaged with the pawls 53 cooperating therewith at both ends, the shaft 52 will be controlled by stopping action in a definite manner.

Turning again to Fig. 12 and recalling that plate 160 is pivotally mounted on shaft 52 it will be realized that by moving plate 160 and its companion 159 slight amounts in a radial direction it is possible to vary the stopping position of shaft 52 because the effective pointed ends of pawls 53 will follow along with the parts associated therewith such as the frame 161 assembled directly on plate 160. The parts that are about to be described are concerned with the manual adjustment for shifting the plates 159 and 160 radially to make the print receiving line positions as they appear on the printing blocks of the continuous forms assembled on the feed belts of the paper feeding unit conform with the printing line of the printer.

Referring to Fig. 4 it is noted that a large bracket 167 is attached to the left side frame 33 and extends to the left out beyond the mechanism of the feed unit and there provides a bearing for the shaft 98 and carries an adjustment knob 168 also shown in Fig. 1 as extending beyond the casing 22 of the feed unit. Turning again to Fig. 4 it will be recalled that shaft 98 was referred to hereinbefore as the guiding means for the top of the sprocket holding plates 94, 95. However, now it is pointed out that shaft 98 performs another function in acting as a tie between the means for adjusting the stop mechanisms outside the right and left side frames. The knob 168 is fastened to shaft 98 so that whenever it is turned by the operator it serves to rotate a pair of bevel gears 169 and 170 fastened thereon. Cooperating with these two bevel gears and at right angles thereto are other bevel gears 171 and 172. Bearings for the latter are provided in the form of brackets 173 attached to the outer faces of the side frames 31 and 33. Extending forwardly from bevel gears 171 and 172 and attached thereto is the pair of threaded adjustment rods 174 each of which passes through a large nut 175 shown in the side view of Fig. 12 to be split and provided with an adjustment screw for tensioning purposes. Extending through each of these nuts 175 is a pivot pin 176 for providing a rocking attachment between each of the threaded rods and the corresponding pawl plate 159 or 160. A pin 176 is suspended between the pawl plate and an outer triangular holding plate 177 fastened to the pawl plate 159 and 160 by means of a pair of studs 178 fixed to the lower triangular edges. At the right side, Fig. 4, the triangular plate 177 has attached thereto a thin spring blade 179 which extends down into contact with the end of shaft 52 and establishes electrical contact therewith, and at the left end the corresponding triangular plate 177 carries the stud 157 already referred to as extending into a notch 158, Fig. 7, formed at the upper end of sector 149 and providing a driving engagement for adjusting both the sector and the commutator wheel 133 secured thereto.

Turning back to general considerations of the stop adjusting means it will be noted now that by rotating knob 168, Fig. 4, and thereby rotating the threaded rods 174 it is possible to impart slight rocking movements to the stop pawl carrying plates 159 and 160 and thereby shift the pointed ends of these pawls so that the wheels 50 and 51 cooperating therewith will come to rest in a selected stop position. It is also clear that through the operation of extending stud 157 shifted along with the stop pawl mechanism there is imparted to the photocell sensing frame through sector 149 a similar adjustment action, and as a third consideration, the position of the commutator wheel 133 is shifted to compensate for adjustment made in the other two members. These adjustment facilities make possible the use of continuous forms in which the printing blocks may have any desired recording positions with respect to the marginal pin feed openings. Therefore, it is not necessary that the printing lines on the form have any particular relationship with the marginal pin feed perforations. Since the device is adjustable it is only necessary for the operator to note how printing lines are to fall on the record material and with respect to the gauged printing line of the apparatus, operate the knob for the stop adjustment and the stopping position will be automatically established in the correct position. And not only will the stop be correctly adjusted, but the line counting arrangement will be varied also because the commutator is shifted to count lines in agreement with

the new position. Then, as a third consideration, the feed control tape need not be varied for the particular kind of form because the photocell devices are also adjusted to compensate for the variance in the position of the printing lines on the form. If a control perforation in the tape TP represents a certain line in the form it will continue to represent that line regardless of the slight variance in positioning of such a printing line because the stop adjsting devices also take care of shifting the photocell sensing openings to cause the tape openings to coincide with different line positions without need for changing the tape or altering its position in general.

The feed unit is provided with a series of paper guides shown in section in Fig. 5 as they are arranged telescopically across the space between the feed belts **44** and **45**.

It is noted hereinbefore with reference to Figs. 9 and 10 that to the outer faces of sprocket holder plates **94** and **95** there are affixed blocks **108** to the tops of which are attached the shields **109** and **111**. Shields **111**, Fig. 2, extend toward the left and right out beyond the main side frames **31** and **33**. Shields **109** extend inward and are curved around the lower ends of the respective holders **94**, **95**, Fig. 10, where they are held as by screws **110**. In Fig. 13 it is seen that the blocks **108** are L-shaped and that the two shields **109** and **111** of the right side are fastened at **181** to the top of a block. It is apparent that as the sprocket holders **94** and **95** are adjusted laterally either closer together or further apart, the two pairs of shields **109**, **111** will follow along laterally and continue to shield the areas immediately to the sides of the pin feed belts.

Between the two shields **109** there is a center space which requires shielding when the belts are extended for a wide form. This space is occupied by two pairs of shiftable shields **182** and **183** and a center fixed shield **184**, Fig. 2. The center shield is fastened to the center frame member **32** and extends equally on both sides of the frame. Attached to the center shield **184** is a bracket **185**, the side pieces of which act as holding means for the ends of a pair of rods **186** and **187**, the other ends of which are supported by the sprocket holders **94** and **95**, respectively. These rods **186** and **187** act as the supporting means and guiding means for the lower ends of the intermediate shields **182** and **183**. Each of these shields is formed with a bent portion **188** which is perforated to receive the rod so that the shield is slidable along the rod. At their upper ends the shields are slidable along the pair of rods **107**, Figs. 13 and 15, already mentioned as passing through the blocks **108** and now it may be pointed out that these rods also pass through the three main frame members **31**, **32** and **33** where they are fixed at the ends and at the center to provide a support and guiding means for the intermediate shields.

In Fig. 13 is it seen that the intermediate shields **182** and **183** are not guided directly on the rods **107** but that there is a series of shouldered blocks secured to the various shields and slidable along the rods so as to provide a telescoping arrangement for the intermediate shields to collapse as the outer shields are brought closer together and to be extended when the outer shields are spread apart.

In Fig. 14 it is seen that one such shouldered block **190** is secured to the underside of the top edge of shield **182** at **191**, Fig. 13 and is formed with an extension **192** which normally abuts against the side shoulder of an extended notch **193** formed at the top marginal edge of shield **109**. This arrangement prevents the shield **182** from moving too far to the left and it also insures that when shield **109** is moved toward the right the adjacent shield **182** is carried along therewith.

A somewhat similar locating block **195** is attached at **196** to the underside of the top margin of shield **183**. This block **195** is formed with an extension **197** having an opening causing it to ride on the lowermost of the two rods **107**. This extension **197** is also in the path of the extension **192** so that there is an abutting relationship when the shields are collapsed so that the movement to the left causes one to be driven by the other. At the opposite end of block **195**, Fig. 14, there is formed another downward extension **198** which cooperates with the shouldered end of a rod **106** fastened in center frame **32** and extending in both directions to provide an outward limiting stop for the movable shields **183**. A lug **189**, Figs. 13 and 17, projecting forwardly from extension block **190**, provides another keying tie between the shields **109**, **182**, and **183**.

With the arrangement shown and described it is apparent that the shields at all times, and in all positions of adjustment of the feed belts, present a closed front over the feed unit and provide a continuous solid backing for the continuous forms, intermediate and to the sides of the marginal feed perforations where they are engaged by the pin feed belts.

In order to hold the margins of the continuous forms on the pins of the feed belts as they are moved rapidly, the feed unit is provided with a pair of top retainers or clamps **200**, **201**, Fig. 2, formed with elongated central openings **202** and **203** through which the upper ends of the feed pins may protrude after passing through the multiple plies of the continuous form. The spring tensioned interior mounting construction of one such clamp is shown in Fig. 3. There it is seen that a bracket **204** is attached to the outer edge of bracket holder **95** and formed with a pair of extensions or ears **205** having pivot openings in which are assembled pivot pins for a similar adjacent pair of overturned fulcrum extensions **206** formed on the clamp **201**. A pair of springs **208** are drawn between the bracket **204** and short extensions on clamp **201** to hold it rocked normally in a clockwise direction. This action tends to hold the clamp **201** down over the margin of the moving continuous stationery and insure that the pins of the feed belt continue to penetrate the marginal feed perforations. When it is desired to remove or thread a set of the continuous forms, the clamp **201** is pulled outwardly; i. e., counterclockwise, Fig. 3, and then the spring **208** is shifted to the opposite side or over dead center of the pivot point and this causes the spring **208** to tend to rock the clamp **201** further in a counterclockwise direction and thereby tend to hold it in the open position.

In order to detect breakage of the continuous form or passage of the end of the record material or any other maladjustment of the material on the feed pins, there is provided a detecting mechanism for sensing the absence of record material adjacent one of the feed belts.

Referring to Fig. 2 it is noted that the opening **202** in the lefthand clamp **200** is much wider than the corresponding opening in the righthand clamp. This extra space is provided for the protrusion of the end of a sensing lever **210** which is also shown in Figs. 4 and 6 as being fastened to the guide rod **186**. Also fastened to the rod **186** is a short arm **211** assembled outside and adjacent to the left sprocket holder plate **94** and in Fig. 6 it is seen that the end of this arm cooperates with the outer actuator of micro switch **212**. As long as record material is present between the shield **109** and the clamp **200** the lever **210** remains rocked in a counterclockwise direction and the switch **212** remains closed. However, should there be omission of record material because of breakage or passage of the end, etc., the lever **210** then becomes free to react to the spring of the micro switch tending to rock it in a clockwise direction and the contacts are opened. The micro switch **212** is fastened to the outer face of holder **94** and the entire assembly travels laterally along the guide tube **100** and carries the rod **186** with the left pin feed belt whenever an adjustment is made for different widths of record material. At this point it is well to note that rods **186** and **187**, Fig. 2, are staggered

in position so that they may approach and pass each other without abutting at the ends.

All the electronic and electrical controls of the feed devices are shown in the diagrams, Figs. 19*a*–19*c* and Figs. 20*a*–20*c*. The set of diagrams, Figs. 19*a*–19*c*, show rather specifically the electronic elements of the photoelectric sensing devices, the clutches and brake controls, etc. in detail, while the other set, Figs. 20*a*–20*c*, is of a more general nature and shows in block diagram fashion the controls in and between the printer and the spacing and skipping controls.

It is noted hereinbefore that two different speeds of paper feeding are provided, an advance of 25 inches per second performed by the spacing clutch and a speed of 100 inches per second by the skipping clutch. The spacing operations are initiated in the printer and carried out by the space clutch and stop devices under control of the commutator, while skipping and overflow operations are initiated, respectively, by the printer and the tape and carried out by combinations of operation of the skipping and space clutches under control of the feed tape and the electronic controls coordinated with the photoelectric sensing devices cooperating with the tape.

It is noted in Fig. 5 that the feed control tape TP is provided with four longitudinal lines wherein appear the perforations **131** for controlling the feed devices. These four channels of feed control are provided in the endless type of control tape similar to the one disclosed in the patent to Mills et al. 2,531,885. Although for illustration there are shown only four channels of control, it is apparent from the patent mentioned that a larger number of such controls may be provided. Each channel of feed control describes a path wherein each hole **131** in the tape moves past a pair of photocell sensing controls **126** and **130**, Fig. 11. The first photocell position that the hole passes may be termed the "slowdown" position while the second photocell location coincides with the "stop" position of the feed movement. The distance between the two photocell positions may be called the slowdown zone because the speed of movement of the record forms is there reduced to the slower or spacing speed while the particular scanned hole in the control tape is traversing this distance. When the control perforation is sensed by the second or stop position photocell **130** a stop pulse is generated which through electronic circuits calls into operation the brakes and stop pawls and holds the movable parts of the carriage at a predetermined position.

The reduction of speed mentioned occurs only if the skip is long enough and if the feeding devices are operating at the higher or skipping speed. This preliminary transfer to spacing speed from skipping speed is made to decelerate the forms to the slower speed so that the brakes and mechanical stops may be applied without overrunning the desired stopping position, as well as to prevent damage to the carriage from the kinetic forces operating at the higher speed.

In Fig. 19*a* it is seen that the "slowdown" tape photocell **126** is connected to a tube **260** and the "stop" photocell **130** is connected to another tube **264**. Just prior to the actual stopping of the feed devices, control is transferred from the control tape TP to the commutator **133**. Assuming that tape channel #**1** is controlling, when the stop pulse storage tube **264** is fired by the stop photocell **130** sensing a hole in the control tape, tube **272**, Fig. 19*b*, is also fired and tube **280** will fire on the next positive pulse from the commutator **133**. Tube **280** through wire **230** fires the brake and mechanical stop control tube **279** to cause energization of the positive stop magnets SM1, SM2 and brake magnets **91**.

When in a stopped position, the commutator brush **153**, Fig. 11, is resting on a communtator segment. Since the hole passing a photocell position causes only the momentary generation of a pulse, it is necessary to provide storage for this pulse. For this purpose there are provided tubes **260** to **263** and **264** to **267**, Fig. 19*a*; the first four of which are slow-down pulse storage controls and the latter four of which are stop pulse storage tubes. There are one slow-down and one stop position tube plus a channel "On-Off" tube such as **273** for each column. The slow-down tube and stop tube for each channel are coupled together by means of a commutating condensor circuit between the plate circuits of these tubes. If one tube is conducting and the other of the tubes so connected is fired, the first tube will be extinguished, thus eliminating any storage which may be in the tube at the time. Thyratrons are used in these applications because two so connected form a stable trigger pair insensitive to a negative pulse on the triggered electrode.

The skip, space, and stop control tubes **277**, **278** and **279**, Fig. 19*b*, are also connected as above noted as well as having an interlock circuit. The communtating condensors and interlock combine to insure only one condition of carriage drive being energized at a given time. Firing of any one of the tubes **277**, **278**, or **279** will extinguish any of the other two which might be conducting.

The interlock circuit relay IR, Fig. 19*b*, is under the control of tube **256** which has grid taps on the output lines from tubes **277**, **278** and **279**. As long as only one condition of paper feed is operative, tube **256** will not fire. However if, for example, control tubes **277** and **278** are both fired due to some error or shorting of the circuits, the potentials of the control grids of **256** will be raised and the tube will fire, picking up the interlocking relay IR. Interlock relay points IR–**1** to **4**, at the right in Fig. 19*c*, will open, breaking the circuits to the skip, space, stop, and brake relays and the carriage will stop before any damage is caused in the drive mechanism.

A pulse as used in this description may be defined in terms of the voltage rise or fall of potential on the line. For example as the commutator blade makes contact with the commutator segment a current will flow and a drop in potential will occur across the commutator. The resultant pulse will be known as a negative pulse. Correspondingly as the blade leaves this segment a positive pulse will result from the current flow stopping with a corresponding rise in line potential.

It is explained hereinbefore how the four sets of electronic controls shown on the sheet of Fig. 19*a* are influenced by the different channels of control tape to have slowdown and stopping effect on the various clutches as controlled by pulses directed to the movement controlling tubes **277** and **278**, Fig. 19*b*, and the motion stopping controls involving tubes **279** and **180** shown on the same figure.

Also on this Fig. 19*b* are illustrated the connections from four other tubes **269**–**271** which are associated with the stopping control tube **280** in such a manner as to control line spacing. They are connected in the form of a Modulo 2 counter. The object of connection is to provide means for single, double and triple line spacing control. The five tubes are wired in such a relationship as to normally present a full condition as evidenced by the activation of tubes **268** and **270** as equivalent to the entry of the digit 2. In effect, the other tube **280** is connected as a sort of transfer tube to be activated by a positive pulse when full conditions of the counter prevail. That is the normal condition for single line spacing. As brought out hereinafter, the printer is designed to selectively emit single or double pulses to either or both of the counter tubes **268** and **270** to subtract therefrom two units and therefore compel the transfer tube **280** to await either double or triple pulses before being conditioned to conduct control further over to the stopping control tube **279**.

It is noted with respect to Fig. 19*c* that certain of the sets of tubes are arranged in a parallel fashion for joint

control of the magnets for the clutches, brakes and stop magnets. The sets of tubes **225**, **243**, **244** and **245** each comprise five tubes connected in a similar fashion between the pulse initiating controls and the operating magnets. These multiplications of control are merely for power purposes and to provide sufficient energy for positive actuation of the magnetic controls.

With the specific showing of the electronic photocell and magnet controls of Figs. 19*a*–19*c* in mind, reference now may be made to the more general showing of Figs. 20*a*–20*c* which illustrate how the printer controls and keys thereon are coordinated with the paper feed controls.

To insure the proper functioning of the feed carriage and to cancel the effect of any previous conditions stored in the circuit, the carriage should be reset before restarting to operate with the printer. When the reset key **309**, Fig. 20*c*, is depressed, the following resetting actions occur: (1) The reset switch **310** is transferred completing a circuit through line **311** and a time delay to tube **273**, Fig. 20*a* (channel On-Off control for channel #1). At the same time, the resultant opened circuit through line **320** to the storage tube **260** of channel #1, removes the B+ supply to tubes **260–267** (photocell storage tubes). This will cancel the effect of any feed control pulse storage in the tubes at the time. (2) Simultaneously, the B+ supply for tubes **277**, **278**, and **279** is cut off, thereby deenergizing any of the clutch, brake or stop magnets **63**, **68**, SM1, SM2 and **91** which may have been energized. (3) Likewise the plate voltage for the tubes **269** and **271** (line space counter) is removed to cancel any line space count in the counter. (4) A pulse from the time delay **312** fires tubes **273** (channel On-Off control) thus selecting channel #1. When the reset key **309** is released, plate voltage is applied to all tubes through line **320** and a pulse from the delay circuit of line **320** fires tube **260** to complete setting up the diode switch **222**, Fig. 20*a*, to pass a pulse through lines **223** and **224** to fire the space clutch control tube **278**. Firing tube **278** raises the grid potential, allowing power tubes **243** to fire and pick up the space clutch magnet **68** as well as conditioning tube **272** (channel release) to fire. As the tape perforation enters the slow-down zone, a pulse from the storage tube **260** issues to tube **278** insuring that the carriage is being driven at spacing speed preparatory to stopping. When the hole in the tape reaches the stop position, a pulse from photocell **130** fires storage tube **264**. This extinguishes tube **260** by means of the commutating circuit connecting the plates of tubes **260** and **264**. Since tube **273** is conducting, diode switch **227** is conditioned to pass a pulse over line **228** to fire tube **272** and thereby condition tube **280** to fire on the next positive pulse from the commutator **133**. Tube **280** fires tube **279** and power tubes **244**, **245** to pick up the brake magnets **91** and mechanical stop magnets SM1 and SM2. The firing of tube **272** also cancels the channel selection by means of a pulse over line **229** which extinguishes tube **273**, the channel selection tube. Tube **280** will not fire until the channel selection tubes have been extinguished thereby raising the screen grid potential of tube **280** by cutting off the plate current through a common plate loading resistor.

When the mechanical stops engage, the record material will be positioned for printing and the commutator brush will have stopped on the next following segment from the segment emitting the pulse which fired tube **280**. One reset cycle is now completed and the hole in the control tape is standing at the stop position of channel #1. A second reset cycle should now be initiated which will complete the ejection of one complete form and insure that the proper photocell pulse storage has been made for one complete control tape cycle. After a reset cycle, the carriage is stopped with the #1 channel selected and at the stop position of the "slow-down" zone.

The electronic line space control counter is made up of two trigger pairs, a commutator for generating pulses, an inverter, and a stop pulse control unit. The counter is normally filled to capacity and multiple line spacing is accomplished by subtracting a predetermined count from the counter prior to the spacing operation and adding one count for each line space desired in excess of one during the spacing operation. A maximum of three line spaces may be obtained in this manner. Any greater number of lines of record movement is produced by a short skip or long skip operation to be described later. All line spacing is under control of the printer in that the initiating pulses originate in the printer circuits and no channel selection is made by the carriage. A pulse from the printer fires tube **299**, Fig. 20*b*, and energizes the space clutch magnet **68** as follows: Tube **299**, line **246**, tube **302**, tube **290**, line **223**, line **224**, tube **278**, tubes **243**, to the space coil clutch magnet **68**. With tube **278** conducting, tube **272** will conduct and, since no channel has been selected, tube **280** is conditioned to fire. The commutator brush of **133** moves off the commutator segment when the space clutch is energized, and a positive pulse issues to fire tube **280**. A pulse from tube **280** fires tube **279** via line **230**. Firing of tube **279** blocks tube **278** because of the commutating condenser between plates of **278** and **279**. This serves to deenergize the space clutch magnet **68** and simultaneously fire the power tubes **244**, **245** to pick up the brake magnets **91** and the stop magnets SM1, SM2, thereby stopping the carriage with the commutator brush standing on the next commutator segment following that from which the space clutch was activated, thus moving the record one line space.

Double line spacing differs from single line spacing by the manner in which a unit is subtracted from the counter. Prior to the time that tube **299**, Fig. 20*b*, is fired by the printer pulse, another pulse from the printer, on line **297**, fires tube **271**, Fig. 20*a*, and extinguishes tube **270** (subtraction) leaving the line space counter minus one count from the full condition. When the line space pulse from the printer fires tube **272**, tube **280** will not be conditioned to fire because the line space counter is not filled. Consequently the first negative pulse from the emitter will not fire tube **280** but will be impressed on the inverter **303** and line space counter by the circuit: Commutator **133**, line **252**, inverter **303**, line **253**, tube **270** and line **254** to the control grid of tube **280**. When the next pulse (positive) issues from the commutator **133**, tube **280** fires, and a pulse over line **230** to tube **270** again cuts off the space clutch control tube **278** and drops out space clutch magnet **68** as the brake magnets **91** and stop magnets SM1 and SM2 are applied stopping the carriage after two line space advances have occurred.

For triple line spacing, Fig. 20*b*, printer pulses over both lines **298** and **297** fire tubes **269** and **271** which (by commutating circuits, Fig. 19*b*) extinguish tubes **268** and **270** to subtract two counts from the line space counter leaving it empty and conditioning the counter for a triple line space control operation. A printer pulse fires tube **299**, Fig. 20*b*, and, as before, energizes the space clutch by a circuit: tube **299**, wire **246**, tube **302**, tube **290**, line **223**, line **224**, control tube **278**, power tubes **243** and to space clutch magnet **68**. As the commutator brush sweeps the commutator **133**, the first negative pulse emitted fires tube **268**, the second fires tube **270**, and the next positive pulse fires tube **280** which in turn fires tube **279** to deenergize the space clutch magnet **68** and apply the mechanical stops and brakes. This stops the carriage with the commutator brush on the third commutator segment after that on which the space operation started, resulting in the carriage moving the form three line spaces. The counter circuits are: a negative pulse from commutator **133**, wire **252**, inverter **303**, wire **253**, to fire tube **268**, a pulse from tube **268** is impressed on time delay over wire **255** and holds tube **270** conditioned to fire until the next pulse from commutator **133**. Tubes **270** and **280** are fired as in double line spacing by the circuit: negative pulse from

commutator 133, line 252, inverter 303, and line 253 to fire tube 270. The line space counter is now filled and tube 280 is conditioned to fire by the rise in its grid potential through line 254 and the condition of no channel selection tubes being fired. The next positive pulse from the commutator 133 fires tube 280 which in turn fires tube 279 via line 230. Tube 278 is blocked and the brake and mechanical stop magnets are energized.

When stopping the carriage and particularly where spacing operations are involved, it is important that the space clutch drive the carriage to the home or stop position with respect to the commutator so that in the home position the carriage is stopped with the commutator brush on a commutator segment. This is accomplished on the carriage by means of the capacitors in the grid circuits of the power tubes 243, Fig. 19*c*. When the space clutch control tube 278 is extinguished by the firing of the brake control tube 279, the power tubes 243 will continue to conduct until the capacitors have been discharged, and the carriage is stopped by the brakes and mechanical stops as the commutator circuit closes on the commutator spot following that spot which fired the brake control tube. The brake control tube 279 is fired as the brush leaves the commutator spot and, if no hold was applied, the space clutch magnet would drop out when the brake magnet was energized thereby allowing the possibility of the brush stopping between commutator spots. Such a condition would prevent energization of the clutches when next required to drive the carriage. The hold circuit provides a positive drive insuring that such a condition will not occur.

A crystal diode 250, Fig. 19*b*, is present in the space clutch line between the clutch control tube 278 and the power tubes 243. The diode "Or" circuit is connected from the clutch magnet line, through a voltage divider to the control grid line of the brake control tube 279. Therefore, when tube 280 fires the brake control tube 279, the diode "Or" circuit will conduct and hold the power tubes 243 conducting until tube 280 is extinguished as the commutator brush closes the circuit on a commutator spot. Thus the space clutch supplies the positive drive necessary to properly operate the feed carriage.

When a skipping operation is required, the skip signal is initiated in the printer and the carriage is controlled, Fig. 20*b*, by the following circuits. The pulse from the printer is entered into one of the storage tubes 281, 282, 283 or 284 over a wire of the lines 231 or 237, depending on which channel is to be selected. If the channel selected is not storing a slow down pulse, for example channel #2, when the stopping condition is brought about when tube 265 is fired, tube 280 is shorted out by the commutator brush resting on a commutator segment and tube 279 is conducting thus energizing the brakes and mechanical stops. As a preliminary to the foregoing, when printer cam P–4 closes, Fig. 20*c*, the double cathode follower 286 will read out a pulse through cable 334 to trigger the channel #2 On-Off control tube 274. When the tube 274 fires, a pulse issues over the diode "And" circuit and wire 228, to fire skip control tube 277 and in turn fire power tubes 225 energizing the skip clutch magnet 63. The circuit is: cam contacts P4 closed and passing a pulse to line 335, tube 286, cable 334 (on channel #2 line), tube 274, diode "And" circuit line 228, tube 277, tubes 225 and magnet 63. Channel selection pulses are over connections which are pluggable and may be derived from any of a plurality of sources in a printer as set forth in detail in the Mills et al. Patent 2,531,885 mentioned before.

As the channel selection is made, a pulse from tube 282, over wire 233, fires tube 288. With tube 288 fired, tubes 289, 290 and 291 are blocked out and cannot fire to generate a space start pulse. With no start space pulse, tube 278 will not fire, resulting in tube 277 being conditioned to fire on the pulse from the diode "And" circuit. Tube 291 is blocked to prevent an overflow pulse from plug socket 292.

Assuming that the skip is a long one involving channel 2 and a change in the feed speed, then as the control hole in tape channel #2 passes into the "slow-down" zone the pulse from the second photocell 126 fires tube 261 and extinguishes tube 265. A pulse issues through diode 242 "And" circuit: wire 223, wire 224, control tube 278, power tubes 243 (control tube 277 is extinguished by the commutator circuit), to space magnet 68. This reduces the paper feed to twenty-five inches per second and allows tube 272 to fire (firing tube 278 raised the gird bias of tube 272) transferring control to the commutator 133. On the next positive pulse from the commutator, tube 280 fires because the space counter is full and then the pulse on line 230 fires tube 279 energizing the stop magnets SM1, SM2 and brake magnets 91 to stop the carriage.

When the skip signal was generated and tubes 290 and 291 blocked, print suppression tubes 293-296 were fired energizing the print suppress relay 300 and print suppress magnet 301. These are controlled by cam contacts C16, P2 and P3 in the printer. A pulse on line 233 blocks tubes 281-284 and 288. Tube 289 fires and pulses tubes 286 and 287 to reset them.

A print suppression pulse is entered from tube 304, Fig. 20*b*, of the printer circuits over line 209 to turn off trigger 299. With trigger 299 turned off, the pulse entered on line 213 is ineffective; furthermore, the diode switch between tubes 289 and 302 is ineffective at the time, consequently, tubes 289 and 291 are blocked allowing print suppression relay and magnet 300 and 301 to pick up.

A short skip is similar in operation to a long skip with the exception of the speed of paper travel. Short skips take place at spacing speed. If, for example, channel #4 is punched for a short skip and a slowdown pulse is stored in tube 263, the pulse from the printer is stored in tube 284 rather than 282, as in a long skip. When cam contact P4 closes, a pulse from 287 (Channel #4 line) is impressed on cable 334 and fires the channel "off-on" tube 276 to complete setting up the diode "And" switch. The spacing clutch control tube is fired by a photocell pulse on the circuit: tube 263, tube 276, diode 245, line 223, line 224, tube 278, power tubes 243 and space clutch magnet 68. Stopping, print suppression and resetting are accomplished by the same circuits as in a long skip operation.

In the illustrative showing channel #1 has been reserved for overflow operations and permanent wiring 347 has been installed from tube 264, Fig. 20*a*, to tube 290, Fig. 20*c*, to carry the overflow signal. An overflow operation may be initiated only during a spacing operation because tube 291 must be conducting before tube 290 may fire, and tube 291 is conducting only when a spacing operation is in progress. Channel selection is made as in other printer control of skipping only this time through plug 192, which may be connected to plug 320, Fig. 20*b*, tube 282, tube 286, cable 334, channel "on-off" tube 274, Fig. 20*a*, tube 265, diode 217, line 228, tube 277, Fig. 20*b*, and power tubes 225 to energize the skip magnet 63. Resetting is the same as in a skipping operation. Any channel may be used for the overflow operation but the wiring 347 must be added from the tube 290 to the particular stop storage tube for that channel, as has been done in channel #1 of the sample showing. Certain well known basic elements such as heater connections, plate supplies, bias supplies, etc., are not shown on Figs. 20*a*-20*c* for the sake of simplicity. Figs. 19*a*-19*c* supply many of the details.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the

art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

We claim:

1. In an automatic control device controlled by a tape having a plurality of control channels for control indicia, means for advancing said tape in synchronism with operation of the control device, a series of sets of sensing devices for said indicia, each set comprising a plurality of relatively adjustable sensing devices for responding to said indicia at variable intervals, and means under control of said sensing devices for effecting a plurality of controls of said device in response to each indicium of the tape.

2. In an automatic control device controlled by a tape having a plurality of control channels for control perforations, there being one perforation located differentially in each of said channels, means for advancing said tape in synchronism with the operation of the control device, a series of sets of photocell sensing devices for said perforations, each set comprising a plurality of relatively adjustable photocell sensing devices for responding to each of said perforations at variable intervals, and means under control of said photocell sensing devices for effecting a plurality of variably timed controls of said devices in response to the plurality of perforations in the tape.

3. In an automatic control device controlled by an endless paper tape having a plurality of control channels for control perforations, said tape being of a length related to a cycle of operation of said device and each of said channels containing one perforation differentially situated to effect one of a plurality of controls at differential times, means for advancing said tape in synchronism with the operation of the control device, a series of sets of photocell sensing devices for each of said tape channels, each set comprising a joined pair of light projecting and light responsive elements mounted on opposite sides of the tape, there being a plurality of said pairs for each channel with the sets related to a channel being relatively adjustable with respect to each other along the channel and along the path of movement of the perforation therein, said related sets of photocell sensing devices responding to said perforations at variable intervals, and means under control of said photocell sensing devices for effecting a plurality of controls of said device in response to each perforation of the tape and within a single operating cycle of the device.

4. In an accounting machine controlled by a tape having a plurality of control channels for control indicia, there being one indicium in each control channel, a pair of control clutches for effecting accounting machine operations, a driving means for said clutches, accounting devices operated by the clutches, means for advancing said tape in synchronism with operation of said driving means, a series of sets of sensing devices for said indicia, each set comprising a plurality of relatively adjustable sensing devices for responding to said indicia at predetermined intervals, and means under control of said sensing devices for effecting operation of said pair of clutches by different ones of said sensing devices at variable intervals to control said accounting devices a plurality of times in response to each indicium of the tape.

5. In a record material feeding device controlled by a tape having a plurality of control channels for control indicia, there being one indicium in each control channel, a slow speed feeding device, a high speed feeding device, driving means therefor, means for advancing said tape in synchronism with the operation of said driving means, a series of pairs of sensing devices for each of said control channels, each pair comprising relatively adjustable sensing devices for responding to an indicium at variable intervals, means for calling into operation said high speed feeding device to move the record material, means under control of the sensing device which is first affected by the corresponding indicium for calling into operation the slow speed feeding device and disabling said high speed feeding device and means under control of the sensing device which is second to be operated by the indicium for disabling both of said feeding devices whereby the record material is brought to a stop gradually.

6. In a paper feeding device controlled by an endless paper tape having a plurality of control channels wherein a single perforation is placed in each channel to control the starting and stopping positions of the record receiving paper, paper feeding means, a slow speed clutch connected thereto, a high speed clutch connected thereto, a driving means therefor, means for advancing said tape in synchronism with the operation of said driving means to make one complete cycle of operation of the tape for each record on a continuous form of said record paper, a series of pairs of photocell sensing devices for said tape channels, there being one pair for each channel and situated to respond at relatively closely spaced intervals, each pair comprising at least one adjustable photocell sensing device for varying the intervals of response to the related perforation, means for calling said high speed clutch into operation for effecting driving motion of the record paper, means under control of the one said photocell sensing device which is first to sense the related perforation for calling into operation said slow speed clutch and disabling said high speed clutch for changing the rate of advance of the record paper and means under control of the second of the pair of photocell sensing devices for calling into operation a stopping mechanism and disabling said slow speed clutch in response to the perforation appearing at said second photocell sensing device concurrently with the appearance of the record paper at the desired print receiving line.

7. In a machine for operating on a record strip, a feed control tape with a plurality of different single feed control indicia for controlling the positioning of said strip to different stop positions, means for advancing said strip and said tape in synchronism, means for operating said advancing means at different speeds, sets of plural photoelectric means for sensing each indicium, and means under control of said sensing means for operating said advancing means at graduated speeds for bringing said strip to predetermined positions.

8. The combination set forth in claim 7 wherein said advancing means includes two magnetic clutches for high and low speeds, and means for shifting control to either of said clutches under control of said tape sensing means to change from high speed back to low speed during long feeding operations.

9. The combination set forth in claim 8 wherein each set of said tape sensing photoelectric means includes a pair of photocells, one of which is in an advanced position relative to the other along the path taken by the tape in moving the indicia thereon across said photocells, said advanced photocell when activated by a related indicium serving to control said shifting means to shift the drive of the clutches from high speed to low speed before the second related photocell is effective to control said advancing means to cause the strip to be stopped.

10. The combination set forth in claim 9 wherein said advanced photocell cooperates with adjusting means for varying its position relative to the other related photocell, whereby the distance through which the tape and strip is slowed down from high to low speed may be varied.

11. In a machine for operating on a record strip, a feed control tape with indicia for controlling the feeding of the strip, means for advancing said strip and said tape, a driving means, a pair of variable speed magnetic clutches between said driving means and said advancing means, a pair of magnetic brakes cooperating with said advancing

means, a pair of ratchet and pawl stop mechanisms cooperating with said advancing means, means for sensing said indicia, means under control of said sensing means for controlling said magnetic clutches to control the speed of feeding said strip, and means under control of said sensing means for operating said magnetic brakes and said stop pawls to engage said advancing means and control the stopping positions of said strip.

12. In a machine for recording on a record strip formed with marginal pin feed openings, a platen for supporting said strip to receive recording impressions, a plurality of low inertia belt tractor pin feeding devices cooperating with said strip, a driving means, a pair of magnetic clutches between said driving means and said tractor feeding devices, a pair of magnetic brakes cooperating with said tractor feeding devices, a feed control tape with indicia for controlling the feeding of said strip, means for moving said tape in synchronism with the movement of said strip, means for sensing said indicia and means under control of said sensing means for operating said magnetic clutches to control the speed of feeding and for operating said magnetic brakes to control the positioning of the strip.

13. In a machine for printing on a continuous record strip having marginal pin feed perforations, said strip being divided into forms, a platen, a pair of plastic belts studded with pins cooperating with said feed perforations to advance said strip relative to said platen, an endless feed control tape of a length corresponding to the length of one of said strip forms, said tape having strip spacing control perforations and feed perforations, a sprocket wheel engaging said tape feed perforations to advance the tape, connections between said feed belts and said sprocket wheel to move them in synchronism, a driving means, a pair of magnetic clutches between said driving means and said connections, one of said clutches being of a higher speed drive than the other, and means under control of said tape spacing control perforations for operating said magnetic clutches to start and stop said record strip and bring it to predetermined form positions at variable speeds.

14. In a record feeding device, means for line spacing the record, means for skip feeding the record, means for stopping said spacing and feeding means to hold the record at predetermined lines, a set of three electron tubes, one for each of said means for controlling its operation, means for selectively rendering said tubes effective to call into operation one of the three means, and electronic means connecting said three tubes so that when any one is made effective the other two are made ineffective, whereby no more than one feeding control means is effective at any time.

15. In a spacing control device, a counter, means for setting said counter to a predetermined value, spacing means for effecting spacing operations, means for subtracting an amount from said counter to determine the number of spacing operations, means under control of said spacing means for adding a unit in said counter for each spacing operation, means for detecting an overflow in said counter beyond said predetermined value, and means under control of said detecting means for stopping said spacing means.

16. The device set forth in claim 15 with means for varying the amount subtracted from the counter by the subtracting means, whereby different numbers of spacing operations are selectively performed.

17. In a spacing control device, an electronic counter, means for pulsing said counter to represent a predetermined value, spacing means, means for controlling said spacing means, means for differentially pulsing said counter subtractively to reduce said value by a selected amount to predetermine the number of spacing operations, means under control of said spacing controlling means for pulsing said counter to add a unit for each spacing operation, means for detecting an overflow in said counter beyond said predetermined value, and means under control of said detecting means for stopping said spacing means.

18. In a device for selecting single, double and triple spacing, an electronic counter comprising two stages of trigger tube sets and a transfer tube to sense a carry pulse, said trigger sets being pulsed normally to represent the value 2, means for spacing, means for controlling said spacing means, means for selectively pulsing said counter to change the status of one or both of said trigger sets to represent the value 1 or 0 to predetermine double or triple spacing operations, means under control of said spacing controlling means for pulsing said counter to add a unit for each spacing operation, and means under control of said transfer tube for stopping said spacing means, whereby one, two or three spacing operations are performed according to whether the values zero, one or two are previously subtracted from the counter.

19. In a program controlled record feeding means, a program storage means comprising a plurality of feed controls, printing devices for recording heading, item and total data on said record, means for advancing said record differentially under control of said program feed controls, a plurality of electronic selection means, means under control of said printing devices for selecting one of said electronic means in accordance with the data recorded, and means under control of the selected electronic means for selecting a particular program feed control to control record feeding.

20. A feeding means according to claim 19 wherein said program means includes a feed control tape with a plurality of feed control channels of indicia, said electronic selection means including pulse storage tubes for each kind of selection, photoelectric sensing means for each channel of indicia, electronic tubes responding to said sensing means, and means under control of a selected storage tube for selecting a certain sensing tube to be responsive to indicia of a certain channel.

21. In a record feeding device, means for advancing the record, means for predetermining the extent of advance by said advancing means, a star wheel operated by said advancing means, said wheel being notched at intervals coinciding with line spacing on the record, a stop detent formed with a wedge shaped tooth for engaging in the notches of said star wheel, a spring tending to disengage said detent, and a magnet for operating said detent to force it into the star wheel at the end of each operation by said advancing means.

22. The feeding device of claim 21 and an electronic line spacing control means, an electronic long feeding control means, and means under control of either of said spacing or feeding control means for energizing said detent operating magnet at the end of an operation.

23. In a machine for recording on a continuous strip divided into forms, recording devices, strip feeding devices, an endless member with indicia for feed control, means for sensing said indicia, electronic line spacing devices responding to said recording devices and controlling said feeding devices, electronic multiple line spacing devices responding to said recording devices and controlling said feeding devices, electronic skip feeding devices operated under control of said indicia sensing means and controlling said feeding devices, electronic overflow spacing controls operated under control of said indicia sensing means and controlling said feeding devices to advance the strip from form to form, electronic speed regulating devices cooperating with said spacing and skip feeding devices under control of said indicia, electronic braking control means operated under control of said indicia sensing means, electronic stopping control means operated under control of said indicia sensing means, and resetting means for eliminating all stored pulses in all electronic devices to render them in a normal condition.

24. In a record feeding device, means for feeding the

record, a commutator connected to operate in synchronism with said feeding means and to emit impulses at line space intervals, electronic line spacing controls for said feeding means, and means under control of said commutator for pulsing said electronic controls to cause line spacing control.

25. In a machine for feeding a record relative to a printing line, means for feeding and line spacing said record, a feed control tape with indicia for controlling said feeding and spacing means with which it is synchronized, photocell means for sensing said indicia and controlling said feeding means, a commutator with contact means geared in synchronism with said spacing means to control said feeding means, a stop pawl and a related star wheel geared to said feeding means for accurate line stopping control, and a common adjusting means for said photocell means, said commutator and said pawl, whereby they are shiftable relative to said tape and feeding means to cause the record to have a selected relationship with respect to said printing line.

26. In a device for printing on record material, a recording means, means for feeding said record material, a feed control program device with indicia for determining the positioning of said record material relative to said recording means, variable speed devices cooperating with said feeding means, a pair of photocell sensing devices, one for operating on said speed devices to change the speed and the other for cooperating with said feeding means to stop the record material at a selected line position, means for adjusting one of said photocell sensing devices relative to the other to vary the period during which a change in speed is in effect, and other means for adjusting both photocell sensing devices relative to the program device whereby said record material may be positioned accurately with respect to said recording means.

27. In a material feeding device, means for advancing said material, a feed program device comprising an endless member with a series of differentially placed feed control indicia thereon, a set of stop control photocells arranged side by side and each in the path of a different one of said indicia, a first set of thyratrons one for each of said photocells for registering the response of the photocell to an encountered indicium, a second set of



thyratrons one for each of the first set for conditioning it to be responsive to the photocell registration, a selecting means for firing a particular one of said second set of thyratrons so that it in turn conditions a related thyratron of the first set to be ready to respond to the related photocell, when an indicium is sensed, means for stopping the advance of said material, and means under control of the selected one of said first set of thyratrons when registering the response of an operated photocell for initiating the operation of said stopping means.

28. The device set forth in claim 27 and including a speed changing means cooperating with said advancing means, a second set of photocells arranged side by side and in advance of the first mentioned set and each in the path of a different one of said indicia for speed changing control purposes, a third set of thyratrons one for each of said second set of photocells for registering the response of the photocell to an encountered indicium, said third set of thyratrons also being conditioned by said second set of thyratrons so that one thereof is responsive to a related one of the second set of photocells, and means under control of the selected one of said third set of thyratrons when registering the response of an operated photocell for controlling the operation of said speed changing means to slow down the advancing material before it is stopped.

29. In a machine for feeding record material formed with marginal perforations, a pair of adjustable endless pin feed devices spaced on the sides of the machine with a gap between them, and a set of telescoping sheet tables in said gap, the end ones of said tables being fastened to said devices to move laterally therewith and the intermediate tables being loosely interconnected and stepped down to telescope together but always present a solid front in said gap.

**References Cited** in the file of this patent

UNITED STATES PATENTS

2,684,746 Bakelaar et al. ---------- July 27, 1954

FOREIGN PATENTS

358,914 Italy ---------- May 6, 1938