Jan. 20, 1942. E. K. PORTMAN-DIXON 2,270,786

SORTING OF PERFORATED CARDS AND SHEETS

Filed May 20, 1940 5 Sheets-Sheet 1

Fig. 1.

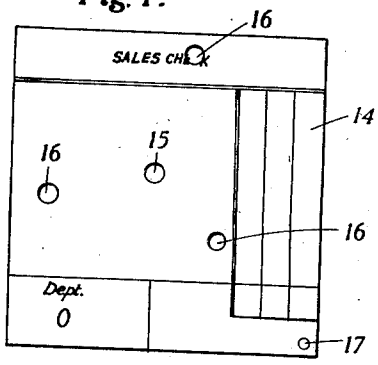


Fig. 4.

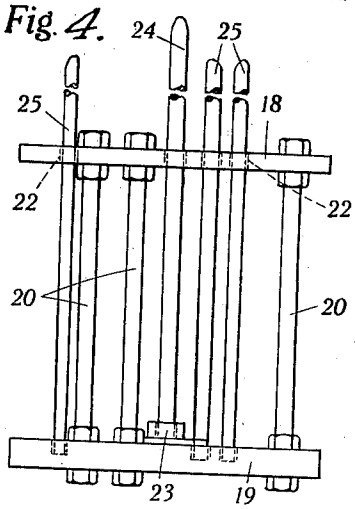


Fig. 2.

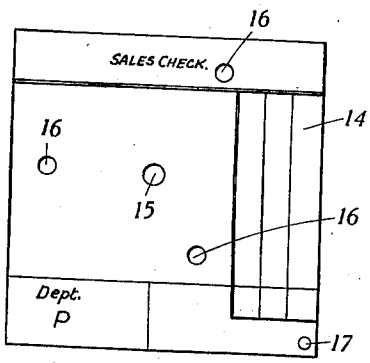


Fig. 5.

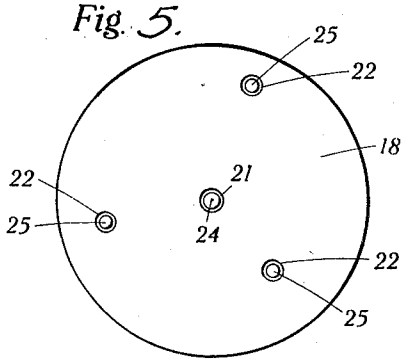


Fig. 3.

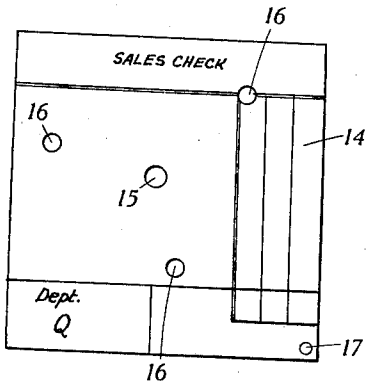
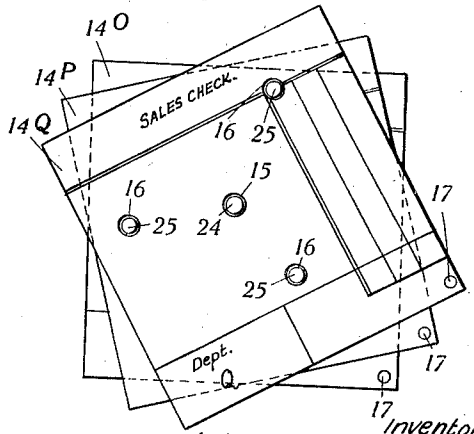


Fig. 6.



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SORTING OF PERFORATED CARDS AND SHEETS

Filed May 20, 1940 5 Sheets-Sheet 2

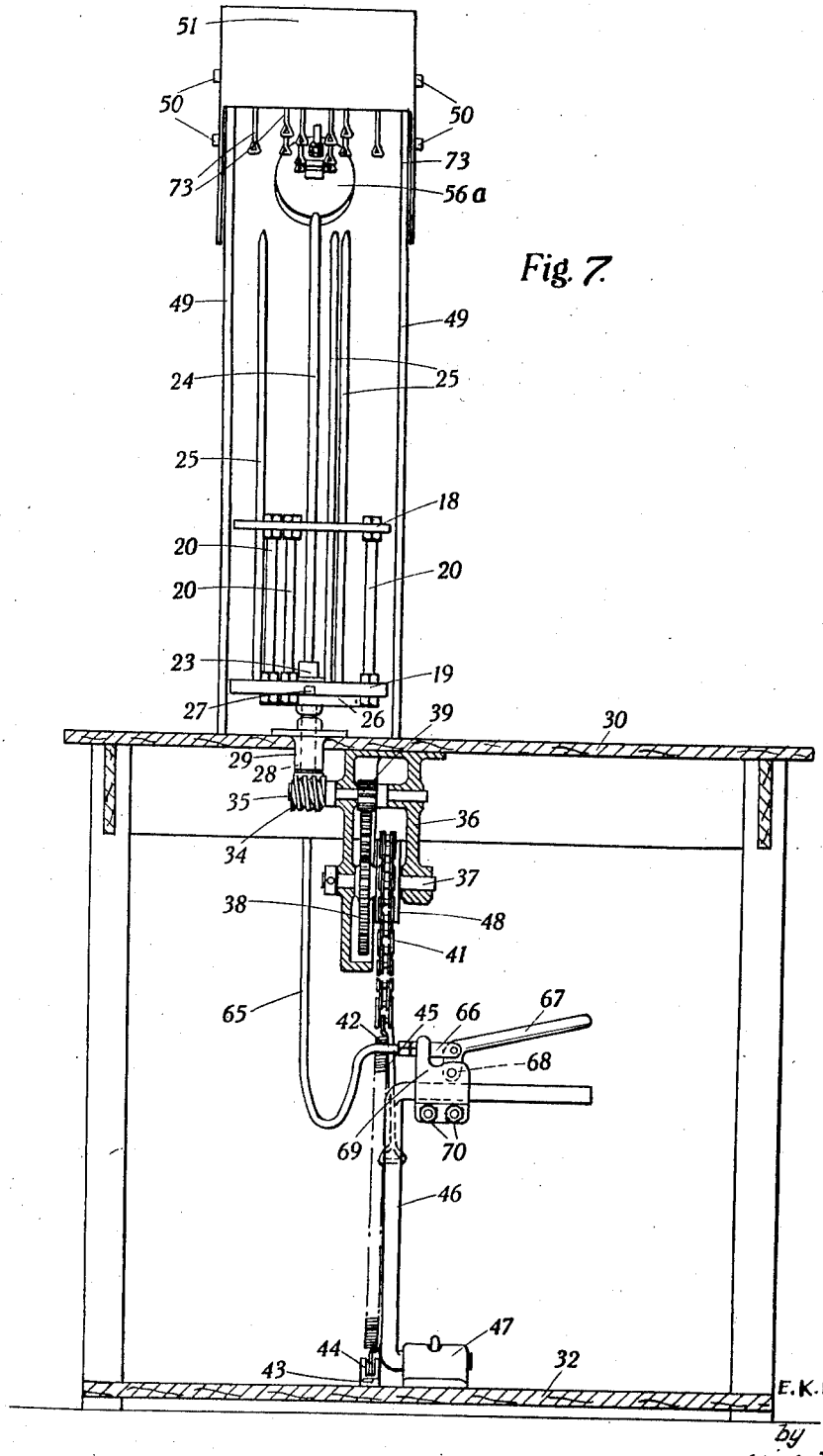


Fig. 7.

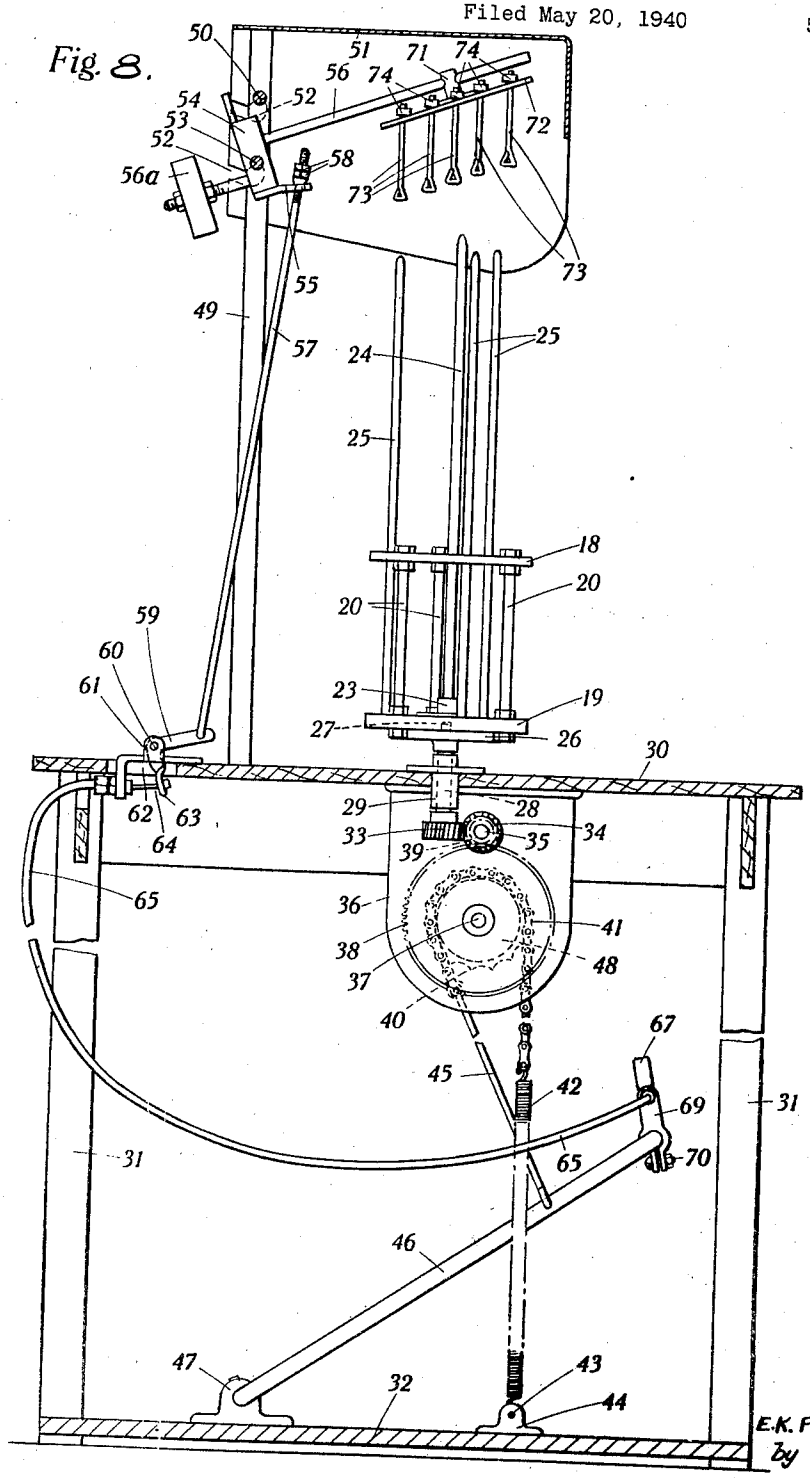
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SORTING OF PERFORATED CARDS AND SHEETS

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Fig. 8.



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SORTING OF PERFORATED CARDS AND SHEETS

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Fig. 9.

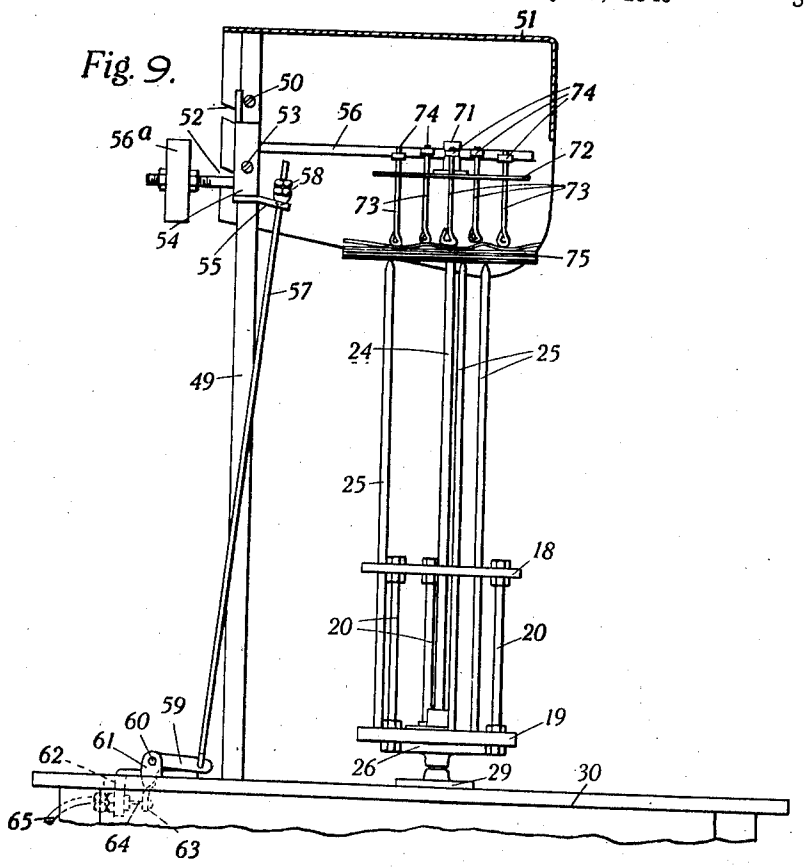
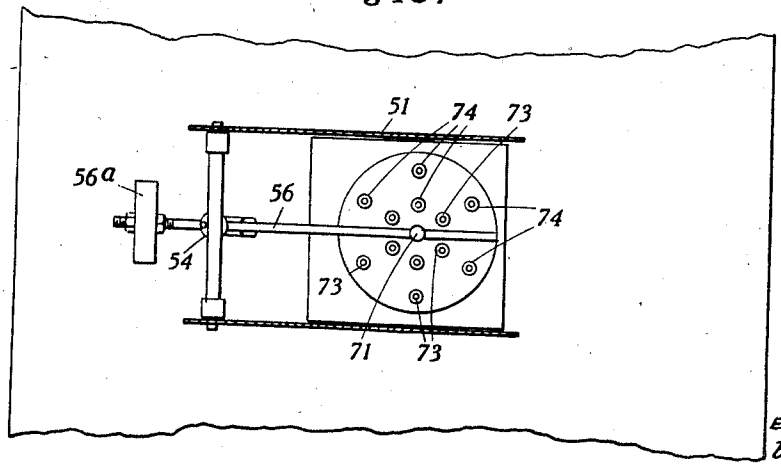


Fig. 10.



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SORTING OF PERFORATED CARDS AND SHEETS

Filed May 20, 1940 5 Sheets-Sheet 5

Fig. 11

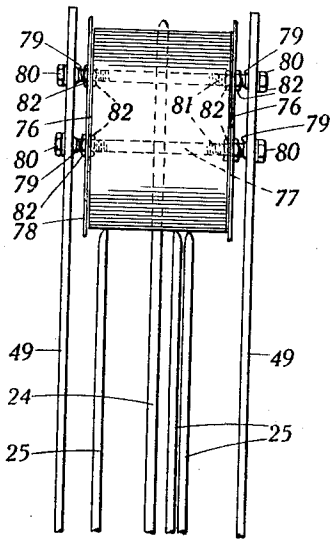


Fig. 12.

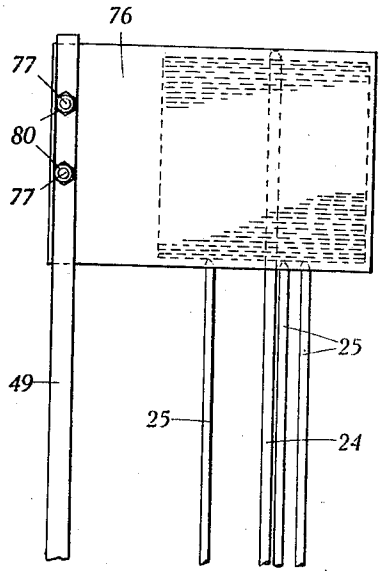
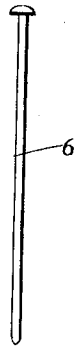


Fig. 13.



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UNITED STATES PATENT OFFICE

2,270,786

SORTING OF PERFORATED CARDS AND SHEETS

Ernest Kemp Portman-Dixon, Teddington, England

Application May 20, 1940, Serial No. 336,297
In Great Britain June 13, 1938

5 Claims. (Cl. 129—16.1)

This invention relates broadly to the compilation of statistics by the segregation or sorting of perforated cards or sheets bearing different characteristics or data, and it has more especial reference, firstly, to the sorting of statistical forms or cards in common use in factories and offices, or for example, to the sorting of the copies of customers' invoices, bills or sales checks retained for record in large concerns such as departmental stores employing numerous sales assistants whose operations require to be classified or analysed, either departmentally or individually, or both, periodically for accountancy and other purposes; and secondly, to the selective sorting of the copies, or the counterfoils, of customers' invoices, bills or sales checks retained by the cashiers in restaurants, multiple-shop caterers, or under other similar conditions in which it is necessary to classify or analyse the shop assistants' or waitresses' invoices or bills daily.

The operation to which the invention is applicable may be regarded as falling into three main categories, that is to say, firstly, the simple selective manual sorting of statistical forms, cards, bills or invoices, or copies or counterfoils thereof; secondly, the selective sorting, by an operator in a special department, of statistical forms, cards, sales bills, sales checks, or any other document, in sheet or card form, requiring to be sorted into a number of different designations, which are received by the operator in a flow; and thirdly, the sorting of statistical forms, cards, sales bills, invoices, and the like when in bulk without reference to order, designation or group.

Consequently, under some conditions, the invention involves simple manual sorting, while under others it includes continuous automatic sorting, the fundamental principle being the same in each case.

The invention is of especial utility in connection with the sorting of thin sheets of paper of the flimsy nature of invoices or sales checks; it is, however, also applicable to perforated record cards, forms or the like.

The primary object of the invention is to enable perforated sheets to be classified or sorted in one operation by being constrained to become threaded individually in succession, about a common axis normal to them, in such manner that sheets of identical characteristics gravitate into groups whereof the angular positions vary for the different characteristics or data concerned, the groups thus sorted in the one operation being thereafter segregated.

Another object of the invention is to provide sheets (which may be in book, pad or other form) capable of being classified or sorted in the above manner and, to that end, formed with one or more perforations, whereof the disposition angularly with respect to an axis normal to said sheets varies for the different characteristics or data concerned; and a further object being to provide sheet-engaging apparatus including one or more sorting members, complementary to said perforation or perforations, whereon said sheets are caused, by the creation of relative angular movement between them and the sorting member or members, individually to become by gravity impaled, each sheet being provided with a segregating perforation in a position common to all of them as is already known.

In one form of the invention, the sheets are perforated according to a diagram or pattern, or to a plurality of diagrams or patterns, common to all, and whereof the position on a sheet changes orbitally of an axis normal to a sheet for the different characteristics or data concerned; and a sheet-engaging sorting device is provided, including a group of threader rods complementary to said perforated pattern upon which the sheets are caused, by the creation of relative angular movement between them and said threader rods, individually under gravity to become impaled in groups having like characteristics.

This angular movement may either be imparted to each sheet, or to the sorting device.

When sheets such as invoices or sales checks which have been folded or crumpled by transmission through a pneumatic or like coin despatch apparatus are to be sorted, means are preferably associated with the sorting device for the purpose of smoothing the creases in the sheets and providing downward pressure so as to enable the perforation therein to register with the aforesaid threader rods.

In order to smooth creased or crumpled invoices or sales checks a holder carrying slidable pins or fingers may be mounted pivotally above the sorting device towards which it may be moved, when required, for the purpose of bringing pressure to bear on a crumpled or creased invoice or sales check.

Should it be desired to subject the sales checks or other sheets to additional statistical sorting or sub-classification, additional perforated diagrams or patterns at different radial distances

from the centre perforation may be made in the sheets.

The invoices or sales checks may either be laid singly on to the apparatus or they may be fed to it from a bundle from which invoices drop singly, for which purpose a special head or hopper into which large quantities of invoices can be loaded may be provided and may include means whereby only a limited number of said invoices are permitted to rest on the threaded rods at any one time so that the correct registrations of the perforations therewith may not be interfered with by the pressure due to the weight of the bundle of invoices.

The sorting device and any associated parts for applying angular movement to the sheets, may be moved angularly by hand, or by treadle and appropriately connected operating mechanism which may be actuated electrically or in any other desired manner, and the same operating medium may bring into action the device smoothing the sheets or means for regulating the feed from the bundle to the apparatus, when incorporated.

The abovementioned several embodiments of the invention are illustrated, by way of example, in the accompanying drawings, in which:

Figures 1, 2 and 3 are plan views of sales checks emanating from three different departments of a store, Figure 4 being a side view, and Figure 5 a plan view, of the sorting device, and Figure 6 being a plan view showing the three sales checks in the positions taken up by them on the sorting device.

Figures 7 to 12 inclusive illustrate a pedal-operated sorting device functioning according to the invention; Figure 7 being a front view of the apparatus, and Figure 8 a side view of the same with a portion of the hood broken away in order to show the parts covered thereby. Figure 9 is also a side view of the apparatus and illustrates the initial operative step in the sorting of a batch of sales checks some of which are shown in place above the sorting device.

Figure 10 is a sectional plan view of the head portion of the machine.

Figure 11 is a detail front view, and Figure 12 is a detail side view, of a hopper or holder for use in the bulk sorting of sales checks or other sheets.

Figure 13 is a side view of one of the sheet-engaging segregating rods which may be employed.

In Figures 1, 2 and 3 there are shown sales checks **14** having slightly eccentrically thereof an axial perforation **15** of which the position is constant on all the sales checks and around which are disposed three perforations **16, 16, 16**, in a triangular diagram or pattern, the position of each group of perforations orbitally with respect to the central perforation **15** varying according to the particular sales department O, P or Q, to which each check is appropriate, and each check is also provided at the bottom right hand corner with a segregating perforation **17**.

The sorting device comprises a stand consisting of two circular plates **18, 19**, secured to and spaced apart by distance posts **20, 20, 20**, the upper plate **18** being provided with a central aperture **21**, and with three apertures **22, 22, 22**, the centers of which should be the same radial distances from the center of the aperture **21** as are the centers of the perforations **16** from the center of the perforation **15**. The plate **19** is formed with circular recesses registering with the apertures **21** and **22**, and with a footstep **23** at its center.

This stand supports removably a series of sheet-engaging members comprising a central or axial post **24** and a group of threader rods **25, 25, 25**, all of which pass freely through their respective apertures in the plate **18** and rest respectively in the footstep **23** and the recesses formed in the plate **19**. The central or axial post **24** is greater in height than the threader rods **25**, and the upper ends of the latter are chamfered in order to facilitate their sheet-engaging action.

In the case of manual sorting, each invoice or sales check **14** is placed by hand with its central perforation **15** over the post **24** down which it drops and rests on the upper extremities of the threader rods **25, 25, 25**; then the check is given relative angular movement by hand to cause it to rotate above the rods **25** until they register with the perforations **16, 16, 16**, whereupon the check falls downwardly of the rods in an angular position determined by the location of the pattern of the perforations **16, 16, 16**, in it; all the checks appropriate to the different departments O, P and Q, assuming the respective angular positions 14^{O}, 14^{P}, and 14^{Q}, shown in Figure 6.

As has been stated above, the angular movement between the perforated sales checks or the like and the sorting device may either be imparted to each sheet or card, as has just been explained, or to the sorting device, and, when it is imparted to the latter, it may be effected manually or mechanically.

It will readily be appreciated that the stand and sheet-engaging rods shown in Figures 4 and 5 can easily be mounted on a known form of turntable geared to a crank handle and fixed on a pedestal or suitable base, and it is therefore unnecessary to illustrate same.

One convenient constructional form of continuous mechanical sorting apparatus for handling statistical sheets such as sales bills, sales checks, and the like individually is, however, illustrated by way of example in Figures 7 to 12 inclusive, to which reference will now be made.

As will be seen from Figures 7, 8 and 9, the stand, consisting of the plates **18, 19**, and the distance or spacing posts **20** and supporting the sheet-engaging axial post **24** and threader rods **25**, is mounted on a turntable **26** having centrally a square dowel **27** engaging a corresponding recess in the underside of the plate **19**, the turntable **26** being carried by a stub shaft **28** supported in a flanged bearing sleeve **29** disposed in an aperture formed centrally of the top **30** of a table having legs **31, 31**, and a shelf **32** near the bottom thereof.

At its lower end the stub shaft **28** has keyed to it a worm **33** which meshes with a worm wheel **34** carried by a horizontal arbor **35** supported in bearings formed in a casing **36** secured to the underside of the top **30**. This casing **36** has bearings for a second arbor **37** which is disposed parallel with the arbor **35** and has keyed upon it a gear wheel **38** which meshes with a pinion **39** keyed to the arbor **35** and also a sprocket wheel **40** over which passes a chain **41**, one end of which is connected to a spring **42** anchored at **43** to a bracket **44** fixed to the shelf **32**, and the other end of which is coupled by a link **45** to a cranked treadle lever **46** carried pivotally by a bearing block **47** secured to the shelf **32**, the sprocket wheel **40** being solid with the outer revoluble member **48** of a free-wheel device of known form. The ratio of the gearing just referred to is so

calculated that depression of the cranked treadle lever **46** to its full extent will transmit to the sorting stand **18**, **19**, **20**, through the agency of the link **45**, chain **41**, sprocket **40**, and the train of gearing **38**, **39**, **34** and **33**, rotary movement to an extent slightly in excess of two revolutions.

In rear of the sorting device a pair of vertical pillars **49**, **49**, are secured to the top **30** of the table, and near the upper end of each of said pillars **49**, laterally extending lugs or pins **50**, **50**, are provided and support a hood **51** formed at its rear edges with bayonet slots **52**, **52**, for engagement with said lugs or pins **50**, **50**.

If desired, the lugs or pins **50**, **50**, may be threaded, and butterfly nuts (not shown) may be engaged therewith in order to secure the hood **51** firmly in place. When the sorting of sheets of different colors is contemplated, the hood **51** may be colored correspondingly with the color of the sheets for the time being dealt with, and may be replaced by a hood of another color when a different colored batch of sheets is required to be sorted.

53 is a rockshaft carried by the pillars **49**, **49**, near their upper ends and having solid with it a block **54** the lower end of which carries an apertured bracket **55** and which also has fixed in it a forwardly projecting stem **56** and a rearwardly extended screw-threaded tail carrying an adjustable counterweight **56***a*. The upper screw-threaded end of a link **57** is secured by nuts **58** in the apertured bracket **55** and the lower end of this link **57** is hooked into the apertured upper arm **59** of a spring-controlled bell-crank lever articulated at **60** to a bracket **61** secured in a slot **62** in the top **30** of the stand, the lower arm **63** of said bell-crank lever being apertured to receive one end of a flexible cable **64** enclosed in a casing **65** and connected at its opposite end by a yoke **66** to an operating lever **67** articulated at **68** to a bracket **69** clipped at **70** to the horizontal upper extremity of the cranked treadle lever **46**.

On the forwardly projecting stem **56** there is secured an apertured and flanged boss **71** to which is attached a circular perforated plate **72** in the perforations of which are freely slidable a plurality of depending pins **73**, the lower ends of which are rounded and the uper ends of which have heads **14** fixed upon them.

The operation of the above described form of the invention is as follows:

A batch of bills or the like, such as is indicated collectively in Figure 9 by the numeral **75**, is placed between the depending sides of the hood **51** and passed by their central or axial perforation over the sheet-engaging axial post **24** until they rest on the upper extremities of the threader rods **25**. The operator then places a foot above the cranked treadle lever **46** and depresses the cable-operating lever **67**, the effect of which is to move the perforated plate **72** angularly downwards and to cause the pins **73** to press on the uppermost bill of the batch, said bill being shown slightly crumpled in Figure 9 in order to indicate the behaviour of the pins **73** which, as will be seen, ride upwardly of the perforations in the plate **72** by varying amounts and by their pressure smooth the bills. Continued pressure of the operator's foot brings the lever **67** hard up against the horizontal end of the cranked treadle lever **46** which, on being depressed to its full extent, causes the sheet-engaging threader rods to be carried round for over two revolutions with their chamfered upper extremities in contact with the underside of the bottom bill, for the time being, of the batch, and to enter the diagram of perforations of each successive bill, the bills being maintained against rotation about the axial post **24** by the depending sides of the hood **51**.

During a single down-stroke of the treadle lever **46** one or more bills will become impaled on the threader rods **25** down which they will slide by gravity in angular positions appropriate to them, as already explained, and each time foot pressure is released from the treadle lever **46** and the lever **67**, these levers are returned by the action of their respective springs to the normal or uppermost position in readiness for further downward movement which is repeated until the last of the batch of bills **75** has been sorted onto the threader rods **25**. The stand **18**, **19**, **20** may then be removed from the turntable **26** and, after segregating rods such as **6** have been passed through the segregating corner perforations of all the groups, the post **24** and rods **25** may be removed from the stand and the grouped bills dealt with as desired.

The apparatus just described provides a means for the rapid intermittent sorting of bills, sales checks, or other sheets, in cases in which the number of individual bills, checks or the like inserted into the machine at any one time is not unduly large. In cases in which it is necessary to present large quantities of bills to the machine, the hood **51** and plate **72** and its associated parts may be dispensed with and in their place a holder or hopper may be secured to the pillars **49**, **49**.

As seen in Figures 11 and 12, two check plates **76**, **76**, may be mounted adjustably on transverse rods **77**, **77**, so as lightly to hold the sides of a batch of bills **78**; the rods **77**, **77**, having stops **79**, **79**, against which the inner faces of the pillars **49**, **49**, abut, and having securing nuts **80**, **80**, secured to their ends. The rods **77**, **77**, also have threaded portions **81**, **81**, on which are screwed adjusting nuts **82**, **82**, to clamp the plates **76**, **76**, in position according to requirements. In this case an axial sheet-engaging post **24** is employed which extends sufficiently far upwardly of the holder or hopper to accommodate a substantial number of bills or the like.

It has already been stated above that, should it be desired to subject the bills or the like to additional statistical sorting or sub-classification, one or more additional perforated diagrams at determined radial distances from the axial perforation may be made in the sheets, and this implies that correspondingly grouped additional apertures may be formed in the plates **18**, **19**, into which either the same or different threader rods may be inserted.

It has been also stated above that the sheet-engaging threader rods **25** are chamfered at their upper extremities in order to afford them a progressive penetration into the perforations in the sheets and to provide a time margin for a sheet to fall during the relative angular movement between it and the threader rods, thus avoiding damage to the sheets or distortion of the perforations therein. In the case, however, of high-speed sorting, it is necessary to bend the upper extremities of the threader rods in the direction of their movement and also into coincidence with the circular path in which the centers of the sorting perforations in the sheets are disposed, so that only a fraction of the surface of the leading face of the upper end of a

threader rod bears on the sheet when it meets a perforation therein.

It is to be understood that the above described manual and mechanical means for sorting and segregating statistical sheets are susceptible of many modifications to adapt the invention to particular requirements.

What I claim is:

1. A sorting device comprising a pair of circular plates, means for connecting said plates together and retaining the same in spaced relation, an axial post removably supported within said plates and having one end extending therefrom, removable threader rods mounted upon said plates and the upper end of said axial post extending beyond said threader rods.

2. A sorting system including a plurality of statistical sheets bearing different characteristics, each perforated according to a diagram common to all and whereof the position of the perforations of one sheet orbitally of an axis normal to the plurality of sheets differs from those of other sheets according to the characteristics of the sheet, with sheets of like characteristics being perforated identically, a sheet-engaging sorting device including a group of threader rods complementary to said perforated diagram whereon individual sheets are caused by the creation of relative angular movement between the sheets and the sorting device to fall by gravity into separately positioned groups of sheets of like characteristics.

3. An apparatus for sorting perforated statistical sheets comprising a base, an axial post mounted thereupon, a sorting post mounted upon said base and spaced from said axial post and said axial post being of greater length than said sorting post, and means for exerting sufficient pressure on the perforated statistical sheets which may have become folded or crumpled to smooth said sheets and to enable the perforations therein to register with said axial post.

4. An apparatus for sorting perforated statistical sheets including a pair of circular plates, means for connecting said plates together and retaining same in spaced relation, an axial post removably supported within said plates and having one end extending therefrom, removable threader rods supported within said plates, the upper end of said axial post extending beyond said threader rods, and means associated with the threader rods for exerting sufficient pressure on the perforated statistical sheets which may have become folded or crumpled to smooth said sheets and to enable the perforations therein to register with the threader rods.

5. An apparatus for sorting perforated statistical sheets including a base, an axial post carried by said base, threader rods carried by said base, one end of said axial post extending beyond said threader rods, means associated with the threader rods for exerting sufficient pressure on the perforated statistical sheets which have become folded or crumpled to smooth said sheets and to enable the perforations therein to register with the threader rods and means for rotating said base.

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