Oct. 15, 1940. J. C. ALLEN 2,217,881

AID TO PRICE ESTIMATION

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Fig. 1.

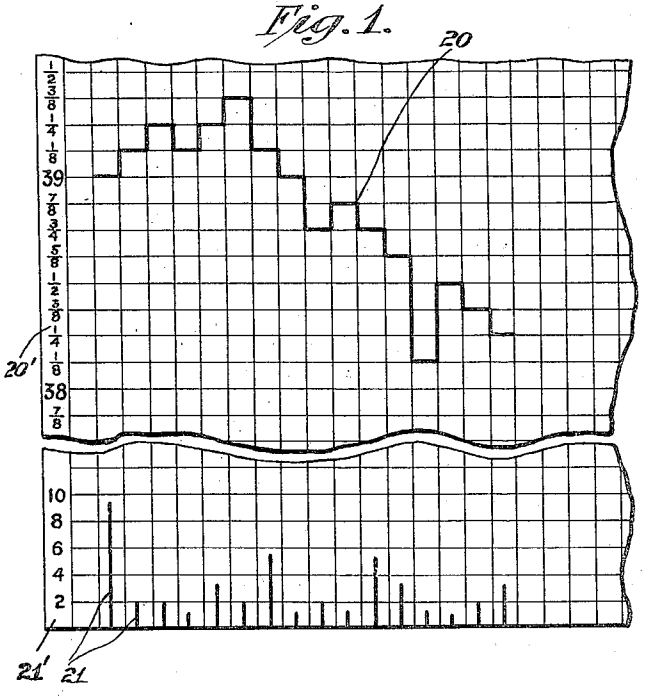


Fig. 2.

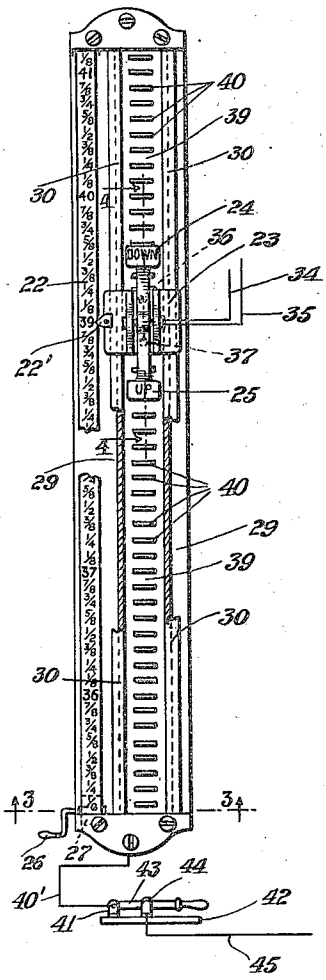


Fig. 3.

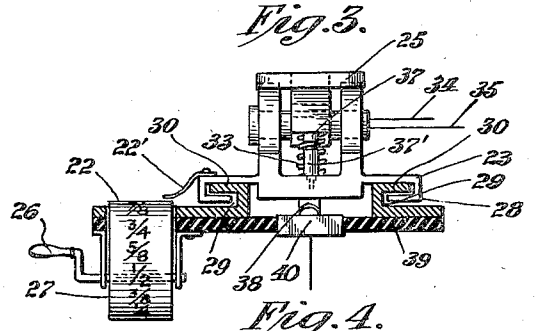
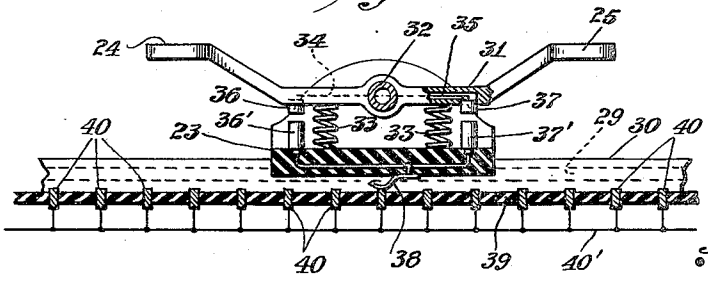


Fig. 4.



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AID TO PRICE ESTIMATION

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Fig. 5.

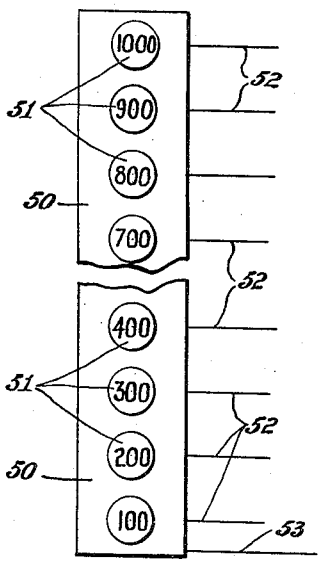


Fig. 7.

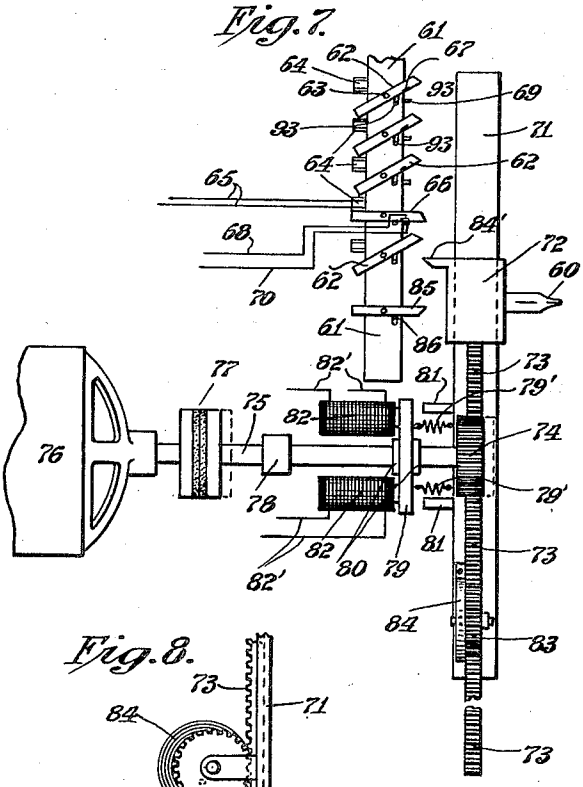


Fig. 6.

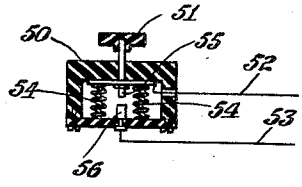


Fig. 8.

Fig. 9.

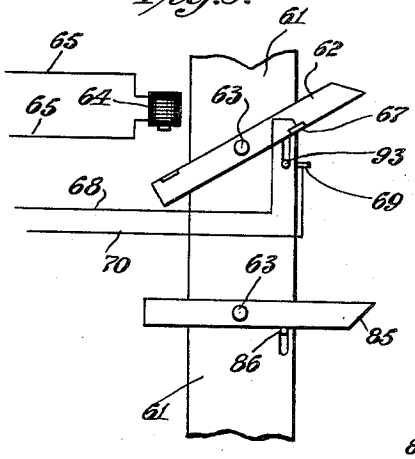
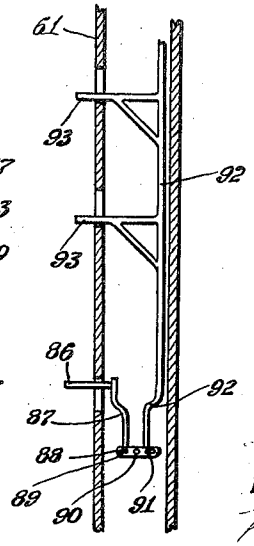


Fig. 10.



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Fig. 11.

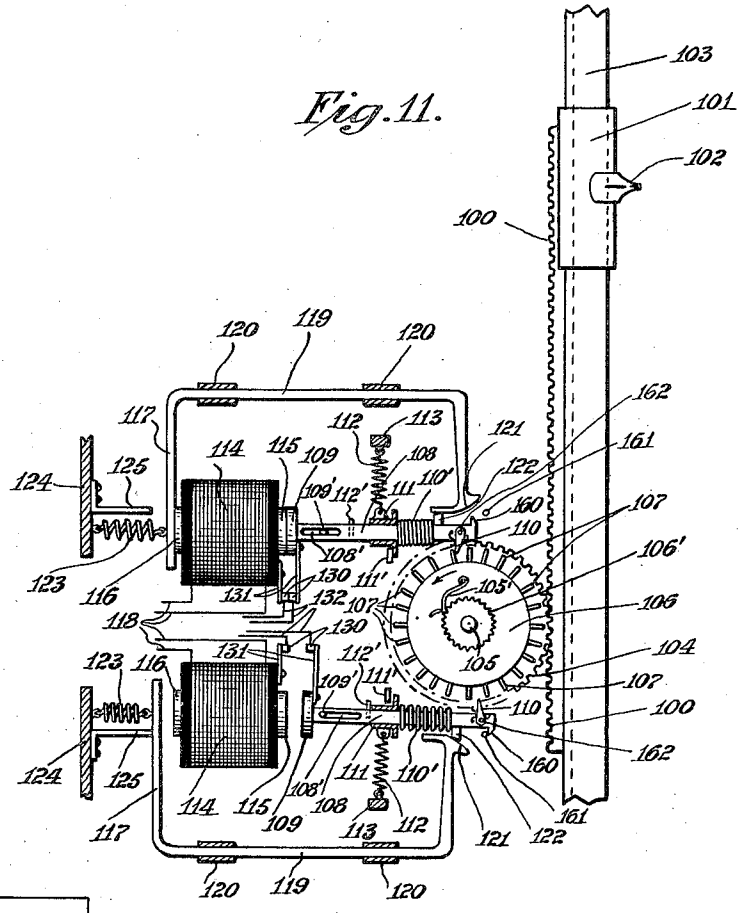
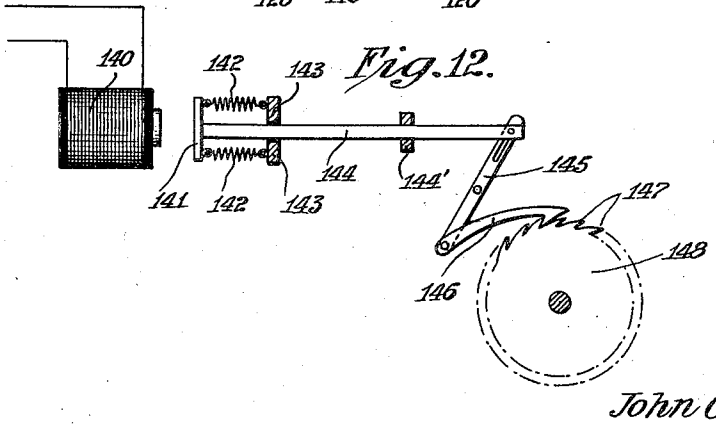


Fig. 12.



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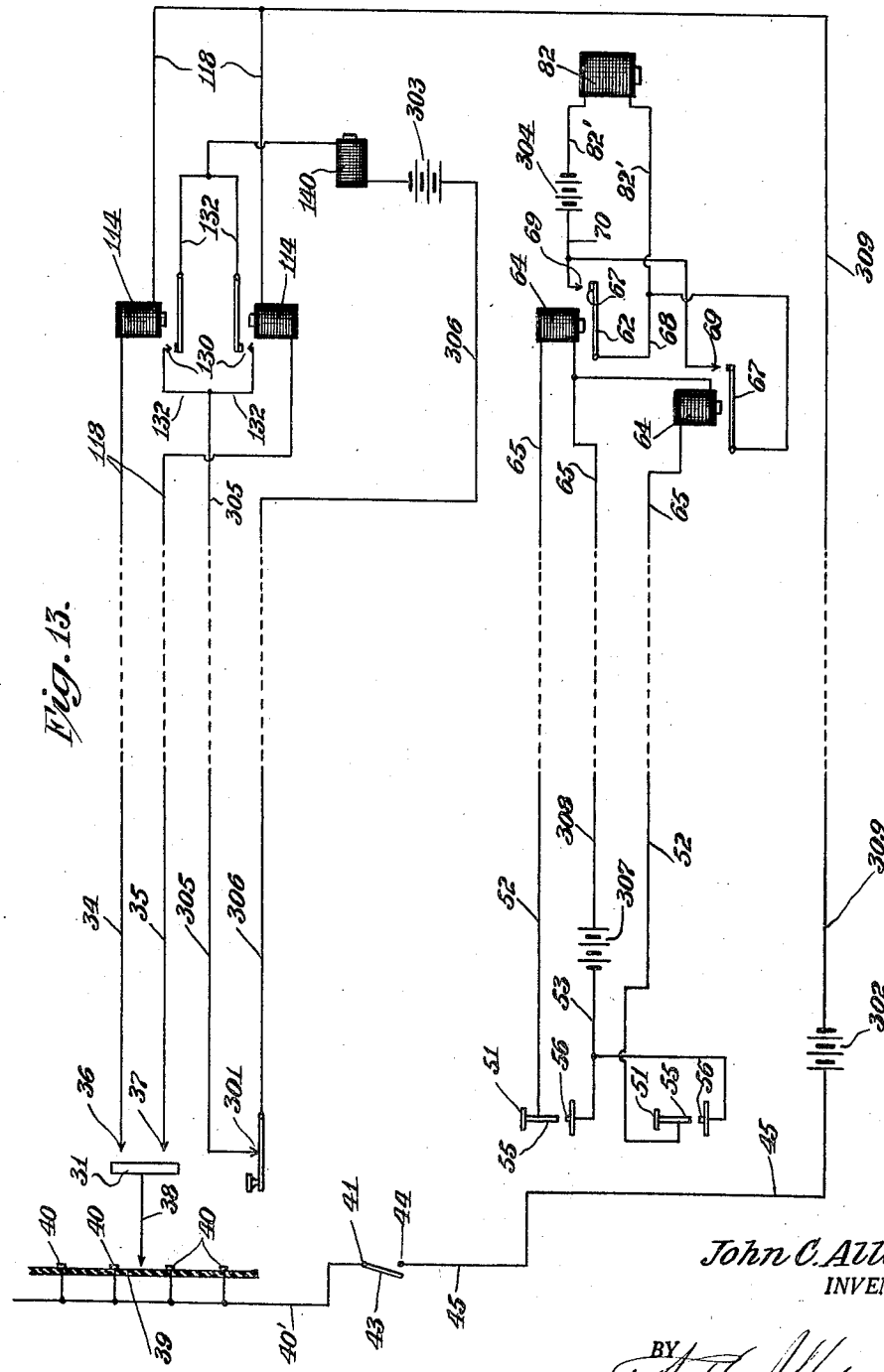


Fig. 15.

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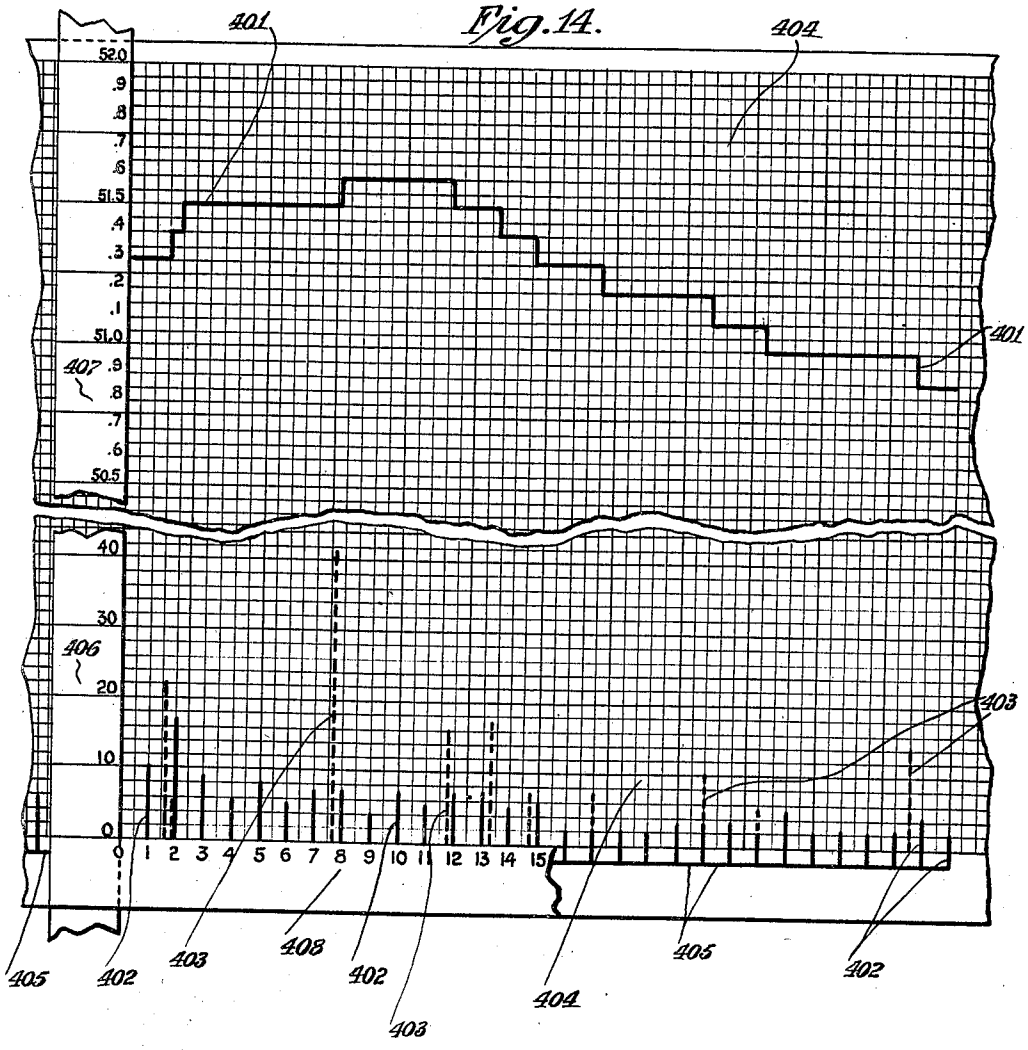
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Fig. 14.



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Fig. 15.

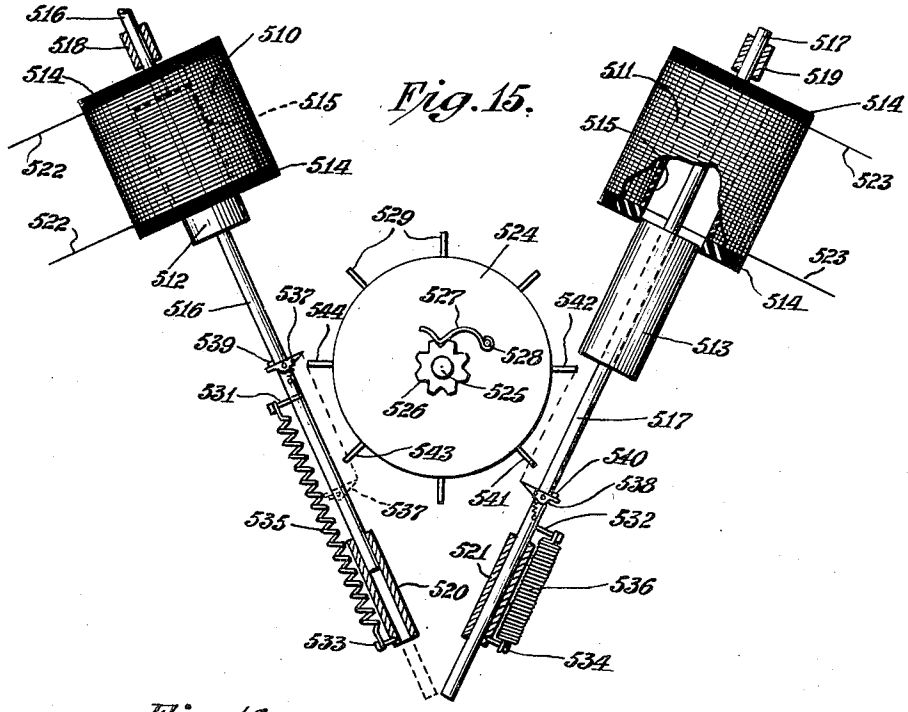


Fig. 16.

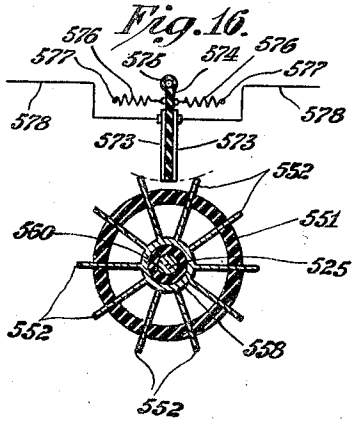
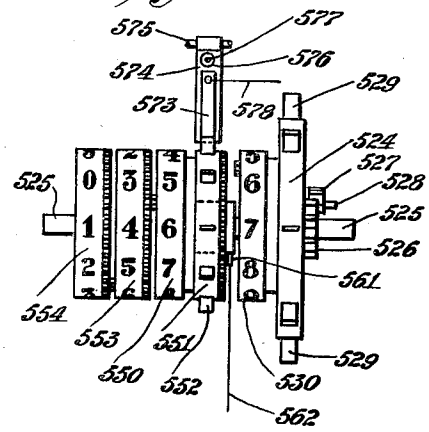


Fig. 17.



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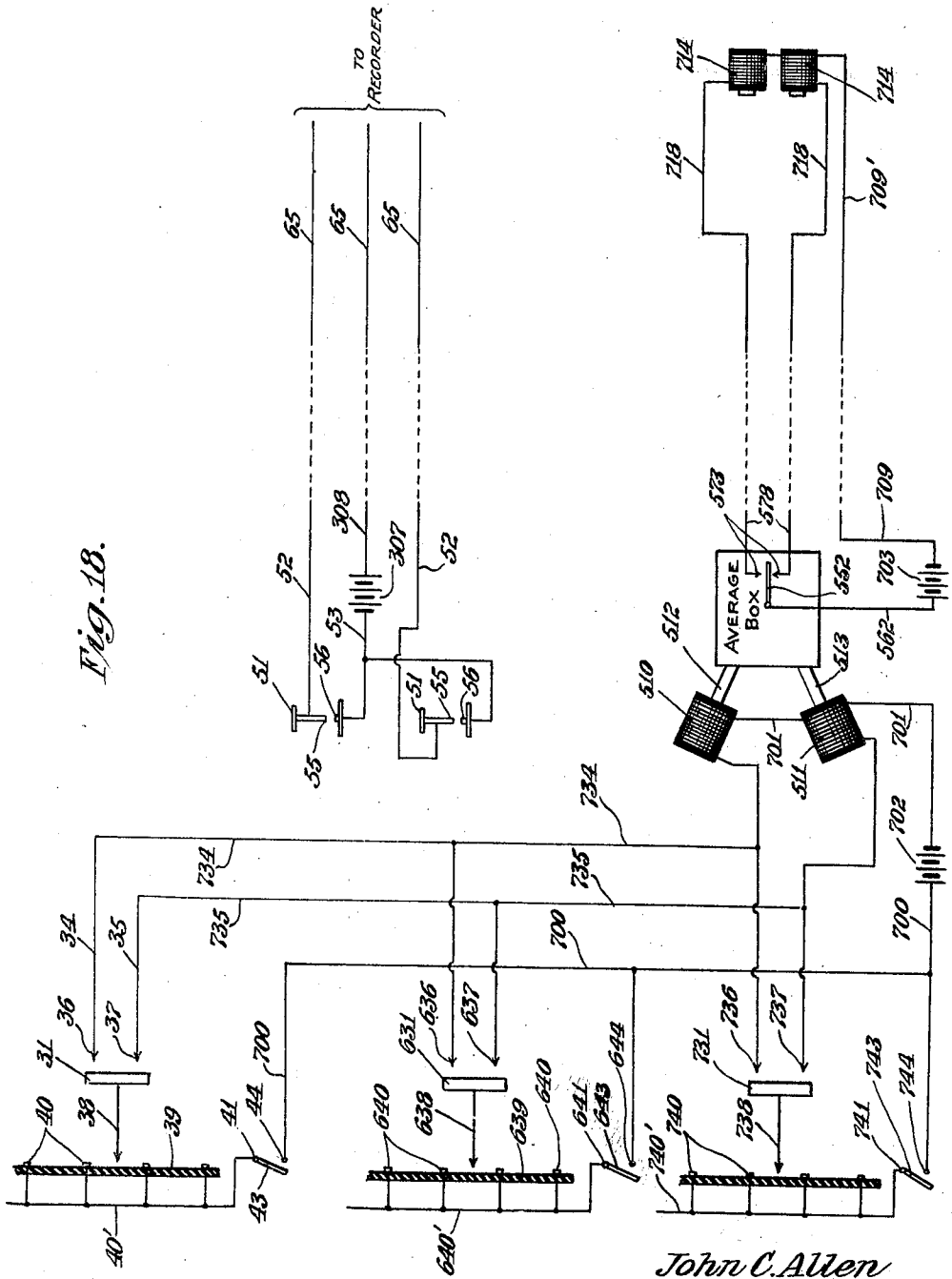
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Fig. 1B.



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Patented Oct. 15, 1940 2,217,881

UNITED STATES PATENT OFFICE

2,217,881

AID TO PRICE ESTIMATION

John C. Allen, New York, N. Y., assignor to Technigraph, Inc., New York, N. Y., a corporation of New York

Application February 18, 1932, Serial No. 593,773

10 Claims. (Cl. 234—1.5)

This invention relates to metods and means for graphically recording changes in the market values of commodities and recording the volume of the transactions or barters in the same commodities which occurred either simultaneously with or immediately preceding the change in value or during fixed time intervals. It also relates to methods and means for graphically recording average values of a group of commodities, in respect to price and volume of transactions therein.

In previous recording methods applied to the prices and transaction volumes of such commodities, the records either have shown the isolated sales and prices expressed in figures and intermingled with one another, as in the familiar ticker tape, or else have shown the price at the end of a plurality of transactions, and the sum total of the transactions.

Both of these methods of recording have many disadvantages which are overcome by my invention. For example the ticker tape demands an operator to segregate and compute the prices and transaction volumes of the desired commodities from other such figures relating to other commodities. This demands unremitting attention on the part of the operator, and the results of his labors are then only visible to a comparatively few persons in the immediate vicinity. Furthermore the delay needed to perform the segregation and computations is highly undesirable.

The other method of representation which adds together a number of transactions and gives prices before and after such a number of individual transactions has many disadvantages. For example, such results are necessarily discontinuous and can only be supplied over rapid communication lines to a large number of interested persons at widely separated intervals, during which intervals no knowledge can be gleaned from the records as to the present and immediate changes of price and volume of transactions.

Today it often is of great economic importance to those buying and selling such commodities, especially stocks, bonds and the like, to know as soon as possible after they occur, such changes of price and the volume sold at a given price level.

The prices and volumes referred to may be those of a single commodity or may be those of a selected group of commodities which are often taken as representative of average values in respect to prices and volumes. Present graphical methods of recording are all subject to such time lag as to render them of greatly decreased or of no value to persons engaged in such transactions.

Another feature of great value for the persons who barter in such commodities is to be aware of the price change resulting from a given single transaction. Since some transactions represent the result of bids by buyers and others the result of offers by sellers, and since these two classes of transactions may have different effects upon the prices, which effects often may be diametrically opposed, a lumping together of diverse transactions, some of which may be of these opposite characters, may cause the cancellation of the effects of the individual transactions. That is, the algebraic summation may be nil or even contrary to the trend of price level at the exact instant when such respects, which lump together a plurality of transactions, are available to the traders in such commodities. Another desirable feature of recording systems is to be able to know at all times the average price of a certain selected group of commodities. Such continuously recorded averages are not possible with any system of recording now in general use.

My invention has for one object to avoid the inconvenience and faults of the above mentioned methods, by recording or registering each and every price change almost instantly after its occurrence and then recording or registering the total volume of sales which occurred at the price level prevailing before the change therein.

Another object of my invention is to record the changes of price and the volume of sales upon such scales and in such relationship to one another that the observer can readily see their relationship both as to values and as to time of occurrence.

A further object of my invention is to allow such records to be rapidly distributed, as, for example, from a central point to one or more distant points.

A still further object is to allow a distributing service to be maintained by one central station, serving a plurality of separated subscribers to the service therefrom.

Another object of my invention is to allow a trader in a given commodity to see graphically and concisely the movements, as to price and volume of sales, of the commodities in which he is interested, freed from the mass of irrelevant data which usually surrounds them, when recorded on the ticker tape.

Another object is to cause recording mechanism at a subscriber's station to move only when

a pertinent change has occurred in the commodity or commodities in question.

A still further object of my invention is to secure a record of the exact numerical average of price and/or volume of a certain selected number of such commodities as represented by stocks, at given intervals of time of very short duration, such as the few minutes or less often elapsing between the successive sales which may cause a change in these average values.

Another object is to furnish a record of the total amount of sales that have taken place in a given group of commodities at certain brief intervals of time.

Another object is to furnish upon a single record sheet graphical indications both of the average price of a group of commodities and the total sales of this same group of commodities, both of these graphical records having a common time scale, so that their relative past and present positions can readily be seen in relationship to one another.

Another object of my invention is to show upon a single record sheet one or both of the graphical representations illustrating average prices and average or total volume sales, together with another graphical representation, made with the same time scale by recording the total volume of sales at intervals which are determined by the instants when the average price curve undergoes some alteration of value.

Further objects and advantages of my invention will be apparent from the following description and drawings, where:

Fig. 1 is a chart illustrating one form of record made according to my invention.

Fig. 2 is a plan view of one form of mechanism which can be used at a data broadcasting point or central station to send electrical impulses which may produce the continuous line price record seen in Fig. 1.

Fig. 3 is an elevation in cross section at the line 3—3 of Fig. 2, shown on an enlarged scale.

Fig. 4 is a detail side elevation partly in cross section on the line 4—4 of Fig. 2 of the mechanism of Fig. 2, shown on an enlarged scale.

Fig. 5 is a plan view of the face of one form of mechanism to transmit the signals producing the volume record at the bottom of Fig. 1.

Fig. 6 is an elevation in cross section of one button of the mechanism of Fig. 5.

Fig. 7 is a partly schematic elevation of one form of recording mechanism for producing the volume record at the bottom of Fig. 1.

Fig. 8 is a detail of one form of pen restoring mechanism as used in Fig. 7.

Fig. 9 is a detail of the upper portion of the signal receiving rack of Fig. 7.

Fig. 10 is a detail in cross section of the restoring mechanism used to re-set the signal rack of Fig. 7.

Fig. 11 is an elevation partly in cross section of one form of a device for securing the price record line of Fig. 1.

Fig. 12 is a partly schematic view of one form of a device for moving the paper record strip of Fig. 1 intermittently beneath the styli which make the records thereupon.

Fig. 13 is a schematic electrical diagram of one form of circuit for connecting together the foregoing various mechanisms of my invention.

Fig. 14 is an alternative form of chart which can be produced by my invention.

Fig. 15 is a vertical elevation, partly in cross section, of one end of the signal receiving portion of an electrical averaging device.

Fig. 16 is a vertical section through wheel 55 and associated electrical contact elements of Fig. 17.

Fig. 17 is a front elevation of part of the mechanisms of Figs. 15 and 16 including the mechanical parts interconnecting them and showing the numerical indicating device.

Fig. 18 is a schematic electrical diagram of one form of circuit including the averaging device, the signal transmitter and the recording mechanism.

In Fig. 1 the upper line 20 represents the price of the commodity which is being recorded according to my invention. The horizontal portions of this line may conveniently be recorded by causing a recording stylus or pen to remain opposite the desired point of the vertical scale shown at the upper portion of the left extremity of this figure, while the paper is moved in a horizontal direction beneath the stylus for a given distance.

The vertical portions of this upper line may be produced by causing the pen to move in a vertical direction while the paper is held stationary beneath it.

The scale 20′ at the upper left portion of this figure is shown as graduated in units and one-eighth of these units and may be either upon the paper as shown or upon a stationary frame beneath which the paper passes in its movement. This is a customary scale as used in recording the price of commodities, such as stocks, bonds, etc., but it is understood, of course, that this scale may be of any suitable nature and may be arranged to be readily shifted to give different sets of values, by any suitable means which do not form part of my invention. It is also understood that the relative motion of the recording stylus and the paper upon which it records may be secured in any other convenient fashion, such as by holding the paper stationary and causing the pen to move in a horizontal direction.

The discrete vertical lines 21 at the bottom of this figure may be produced by a similar recording stylus which moves in a vertical direction and returns to the bottom or non-recording point during intervals while the paper is held stationary. When the paper is moved horizontally the pen which makes this record will either be completely off the record paper or will record upon a portion of the same which may be shielded from view.

In this form of chart the lower record may represent the volume of transactions in the commodity whose price is represented by the upper line. A scale 21′ in any suitable units, such as the one illustrated at the lower left of the figure, may be employed to indicate the approximate absolute value of the volume of sales.

A convenient unit often employed for recording sales of stocks and bonds is that of 100 share lots, in which case the numbers at the lower left side of this figure are each to be multiplied by 100 to represent the actual number of shares traded, in the case of the chart illustrated herein.

In the case of this lower record it is also to be understood that the lateral displacement of successive vertical lines may be secured by any device giving a relative horizontal motion between the recording pen and the paper, such as a movement of the paper or of the pen itself in a horizontal direction.

The upper or price line and the lower or volume line in this figure may bear certain relations to one another according to the following principles.

The upper line moves one unit in a horizontal direction, such as toward the right, and then remains stationary until the price of the given commodity is altered, either up or down. When this alteration occurs, the pen making this line is moved a corresponding number of units in an upward or downward direction, and then another relative horizontal movement of pen and paper of one unit is made, the system finally coming to rest.

The lower vertical lines represent the volume of trading which has occurred in the given commodity during the interval when its price level remained unchanged. These lower lines represent numerical factors which are secured by the addition of individual sales occurring while the commodity remains at one price level. Accordingly an adding operation is necessary before the value of these vertical lines can be known, while the change of the price level indicated by the upper pen can be enregistered as soon after it occurs as the mental and physical reactions of the observer have occurred and the operation of the actuating and recording mechanism hereinafter described has taken place.

It will usually be found that an observer of this chart will desire to have a change of price indicated at soon as possible, and therefore the upper price line may make its change of indication as soon as a change of price occurs, and the lower or volume line may be drawn as soon thereafter as the computations and transmissions thereof are completed. However, it may be desirable in certain instances that the volume be enregistered before, or simultaneously with, the price, and the general principles underlying this form of my invention are not thereby altered.

In Fig. 2 is illustrated a convenient method of sending a series of electrical impulses to a point which may be remote from the operator of the device and which impulses will serve to bring about the vertical movements of the pen and/or the horizontal movements of the paper which give rise to line **20** of Fig. 1. Since my invention may conveniently include a plurality of devices for producing charts such as those of Fig. 1 simultaneously at a large number of separated points, it is desirable that the medium of communication between the observing operator and the recording mechanism be one capable of acting in a very short interval of time, over convenient interconnecting channels. Since electrical means of transmission have these desirable qualities, I have illustrated my recording mechanisms as being actuated through an appropriate electrical device and means of communication, but it is to be understood that other means of communication, such as pneumatic, mechanical or the like may be used.

The scale **22** at the left of Fig. 2 corresponds to the upper left scale of Fig. 1 and the mechanism hereinafter described secures the result that a movement of the sliding member **23** to any given position as shown by its indicating pointer **22'** shall cause the stylus which is drawing line **20** to take up a vertical position corresponding to this indication on the scale of the device of Fig. 2. The sliding member **23** is equipped with two finger tabs **24** and **25**, labeled respectively "Down" and "Up." Any suitable mechanical braking device (not shown) may be employed in connection with these two tabs so that member **23** will remain in a given spot and not be accidentally dislodged therefrom unless one or the other of these tabs is depressed.

Referring now also to Figs. 3 and 4, at **26** is shown a small handle which serves to rotate a spool or reel **27** upon which is wound the strip **22**. Another similar spool (not shown) may be used at the upper extremity of this scale or an automatic rewinding reel may be used at this point to retract the scale when loosed by the bottom reel **27**. By means of the rotation of handle **26** the price scale may be shifted, so that indicating pointer **22'** will show a different figure without any movement of sliding member **23**. Sliding member **23** may be equipped with edges suitably bent as indicated at **28** to engage in grooves **29**, lying along the edges of a fixed track **30**.

Sliding member **23** also has an upper movable bar **31** preferably of insulating material, which serves to bear finger tabs **24** and **25** and which is mounted to be capable of a rotary motion through a limited arc around a pivotal point **32**. Mutually balanced compression springs **33** serve to normally maintain bar **31** in a position parallel to track **30**.

Two conductors **34** and **35**, made of suitable flexible material so as to allow ready movement of slider **23**, enter bar **31** at its center point but are insulated therefrom and terminate in suitably insulated contacts **36** and **37** upon the lower surface thereof. Beneath each of these contacts is a corresponding stationary lower contact **36'** and **37'**. When finger tab **24**, for example, is depressed bar **31** will pivot around point **32** and movable contact point **36** will be brought into engagement with fixed contact point **36'** through the necessary compression and expansion of springs **33**. The electrical circuit from both stationary contact points **36'** and **37'** is made through a common sliding contact **38** which is carried by the body of sliding member **23**, but suitably insulated therefrom, if the latter be of conducting material. A similar depression of tab **25** will result in a connection of contact points **37** and **37'**.

Parallel to track **30** is an electrical track **39** formed of suitable insulating material and provided at intervals with electrical contacts **40** connected with one another and having a common electrical connection by wire **40'** with pole **41** of switch **42**, whose moving blade **43** engages a fixed contact **44** when it is closed. A conductor **45** leaves this fixed contact and connects to a suitable source of energy as hereinafter described.

The general operation of the impulse transmitting mechanism of Figs. 2, 3 and 4 is as follows. Slider **23** is placed at the approximate middle point of its path. Switch **42** is then opened and scale **22** is moved vertically by means of handle **26** until pointer **22'** is opposite the value of the commodity existing at the moment when the operation of the device is commenced. It is understood that a similar scale shifting mechanism (not shown) may be employed at the recording chart of Fig. 1 to allow a similar initial adjustment of the stylus and scale of values indicated thereby, if so desired. Switch **42** is then closed and when the price of the commodity undergoes alteration, the oeprator will place his finger in the appropriate finger tab and bring sliding member **23** to such a position that indicator **22'** will be opposite the new price value. The pressure upon the finger tab causes sliding contact **38** to be connected to one of the two conductors **34** or

35, corresponding to the tab depressed. The longitudinal movement of sliding member 23 will cause the sliding contact 38 to pass over a number of contacts 40 equal to the number of units passed over by indicator 22'. It is to be understood that contacts 40 are to be of a number corresponding to the price units indicated upon scale 22 and are to be spaced at distances from one another corresponding to the spacing of the price units.

This combined movement of pressure upon the finger tab and longitudinal displacement of the sliding member 23 give rise, then, to a series of electrical impulses correspondent in number to the total number of units of the price change, which impulses are transmitted over the conductor corresponding to the direction of this change, i. e., whether up or down, and arrive at the recording mechanisms hereinafter described.

In Fig. 5 there is shown an enclosing box 50 bearing upon its upper surface a series of push buttons 51 marked with figures indicating the volume of sales in appropriate units. These buttons may be of any suitable number, in accordance with the range of volume of the individual sales. At 52 are shown the individual conductors which proceed from one side of each individual push button and extend to the individual magnets located at the recording apparatus. The other side of all the contacts are joined together by a common conductor which proceeds as indicated at 53 ultimately connecting to the recording apparatus. This conductor serves as a common return for the individual circuits controlled by their respective buttons.

In Fig. 6 button 51 is shown as pressed upwardly by springs 54. When pressure is applied to this button these springs are compressed and the upper contact 55 is brought into engagement with the lower contact 56, thus completing the circuit through this particular button.

Referring now to Figs. 7, 8 and 9, the mechanism is shown which causes the recording pen 60 to rise vertically over the record when button 51 is depressed and then causes it to automatically return to the zero point. At 61 is represented a suitable support, bearing along one side a series of hinged members 62 rotatable through a limited arc upon pivots 63. At 64 is indicated one electromagnet actuated through conductors 65 by the current proceeding from button 51. It is to be understood that a similar electromagnet is employed in the same position relative to each one of the movable members 62, although the other electromagnets have been omitted from the drawing for the sake of clarity. These members 62 are normally in the inclined position indicated by those represented in the drawings without electromagnets. At 66 is indicated one of these members in the horizontal position which it assumes under the influence of electromagnet 64 when the latter is excited. Movable member 66 is so balanced that it will remain in the inclined position when magnet 64 is not excited, but will remain in the horizontal position, when once drawn there by magnet 64, even though the exciting current to this electromagnet has been discontinued.

At the right hand portion of member 62 is indicated a movable contact 67 located upon its underside and having connected thereto a suitable conductor 68. At 69 is indicated a fixed contact, also connected to another conducting wire 70. Contacts 67 and 69 are so arranged as to form an electrical connection when member 62 assumes a horizontal position.

At 71 is indicated a suitable track upon which slides carriage 72 carrying pen 60 affixed thereto. This pen carriage has affixed thereto and projecting downwardly therefrom, a toothed rack 73 which serves to move it along track 71. Rack 73 is actuated by gear wheel 74 which is arranged with teeth of sufficient width to furnish driving power to rack 73, even though only in partial engagement therewith. Gear wheel 74 is fixed to one end of shaft 75, whose other end is driven from motor 76 through clutch mechanism 77.

Shaft 75 rotates in suitable bearings 78 and is capable of longitudinal as well as rotational movement therein. Armature 79 is journaled on shaft 75, so that the latter may rotate with respect to said armature, but flanges 80 upon shaft 75 cause armature 79 to impart to the shaft any longitudinal movement to which the armature is subjected. Stops 81 affixed to stationary track 71 limit the horizontal motion of armature 79, and consequently that of shaft 75 in one direction. Electromagnets 82 serve to limit the horizontal motion of armature 79 in the other direction, and also to determine its movement in that direction when they are excited through wires 82'. It is understood that armature 79 is of suitable magnetic material. Springs 79' serve to retract the armature when the excitation of electromagnets 82 is discontinued.

In Fig. 8 is indicated in detail the mechanism which serves to impel toothed rack 73 in a downward direction, when no other force is acting upon it. 83 indicates a toothed wheel engaging with rack 73 and actuated so as to be rotated in one direction by means of a coiled spring 84 affixed thereto and to a stationary point in any suitable fashion. This coiled spring is of sufficient size to allow toothed wheel 83 to rotate a sufficient number of times so that rack 73 can pass sufficiently beneath the wheel. Spring 84 is also arranged so that it will be under tension when rack 73 is at the upper end of its vertical traverse, thus causing spring 84 to act as a restoring force tending to move rack 73 to its lowest point, when no other portion of the mechanism is imparting any contrary force thereto.

Carriage 72 has affixed thereto actuating finger 84', which is arranged to engage movable member 66 and cause it to assume an inclined position as carriage 72 is impelled upwardly by means of rack 73 and its associated driving mechanisms.

At 85 is indicated a special movable member not actuated by any electromagnet, but capable of rotation through a limited arc.

Referring now in addition to Fig. 10, a movable member 85 is so balanced as normally to rest against pin 86, but also is so arranged that it exerts no force thereupon sufficient to move the pin, unless it is actuated by external forcible means. When movable member 85 has imparted to it by finger 84' a motion in a counterclockwise direction, it will turn without affecting pin 86, but when a clockwise motion is imparted to it, it will exert a downward pressure upon pin 86. Pin 86 has affixed thereto bar 87 which is connected by a sliding joint 88 with pivot bar 89 rotating upon an axis 90. Another sliding joint 91 connects pivot bar 89 with vertical member 92. Member 92 extends vertically along the entire length of support 61 and bears along its length suitable supported horizontally projecting pins 93, whose extremities are located beneath one end of movable members 62 and 66, and are capable of a vertical motion which will impel these mov-

able members into an inclined position when the pins are pushed upwardly.

The operation of the mechanisms of Figs. 5, 6, 7, 8, 9 and 10 is as follows. The operator at the central station depresses a button 51 corresponding to the volume of sales which it is desired to record. Closure of the contacts of this button causes a current to flow and actuate electromagnet 64. Electromagnet 64 causes inclined movable member 66 to assume the horizontal position shown in Fig. 7. This movement closes contacts 67 and 69, thus closing the circuit between conductors 68 and 70. The closure of this circuit causes electromagnets 82 to be excited. These magnets when excited attract armature 79.

The horizontal movement of this armature imparts a corresponding horizontal movement to shaft 75 which engages clutch 77 and causes shaft 75 to be set in rotation by motor 76, which latter is in continuous motion while the mechanism is in operative condition. The rotation of shaft 75 causes gear wheel 74 to impart an upward vertical motion to rack 73 thus elevating pen carriage 72.

When the finger 84' affixed to pen carriage 72 comes in contact with movable member 66 in the horizontal position of the latter, it causes it to rotate counterclockwise, thus breaking the circuit of conductors 68 and 70. The opening of this circuit causes electromagnets 82 to no longer be excited, thus allowing springs 79' to retract armature 79 and disengage clutch 77. Spring 84, which has been wound up during the vertical ascent of pen carriage 72, now exerts its stored energy by unwinding and pulling down pen carriage 72 to its lowest position.

Finger 84' of the pen carriage during its upward traverse has rotated movable member 85 in a counterclockwise direction sufficiently to allow it to pass by the same, which then resumes a horizontal position. When traveling downward, finger 84' engages member 85 and rotates it in a clockwise direction as it slides by the same, thus pushing downward pin 86. Pin 86 through its connecting bars, pivots and pivotal member 89 imparts an upward motion to vertically moving member 92. One of the pins 93 which project from member 92 then acts upon the movable member 62 which has assumed a horizontal position, such as indicated at 66, and pushes it back into its normal inclined position.

In Fig. 11 is shown a movable rack 100 bearing at its upper end a carriage 101 equipped with a stylus or pen 102 for marking the price line of Fig. 1. This carriage and driving rack slide upon a suitable track 103 and are arranged in such frictional relationship to the track that they will remain immobile in any given position along its length until some force acts to move them in a vertical direction.

Rack 100 is actuated by a gear wheel 104 which engages its lower portion. Gear wheel 104 is rigidly fixed upon the same shaft 105 as a wheel 106, which latter bears upon its periphery a series of projecting fins 107, and is kept relatively immobile by a light spring 105' engaging the indented peripheral surface of holding wheel 106', also upon the same shaft as gear wheel 104. The spring 105' has one end fastened to a suitable stationary or non-rotating part of the mechanism.

At each side of these wheels is a movable tractor member 108 furnished at one end with an armature 109 and at the other end with a hook-like projection 110 adapted to engage fins 107 of wheel 106. Members 108 have slits 108' sliding upon fixed pins 109' and also slide in suitably mobile sleeves 111 in which they are capable of a longitudinal motion, being normally retracted from the electromagnets by springs 110' compressed between push rods 122 and sleeves 111. The sleeves 111 are capable of limited motion in a direction at right angles to their length and tensile springs 112 affixed to suitable supports 113 tend to maintain these sleeves in a position so that projections 110 on member 108 will not engage fins 107.

These sleeves are also restrained from approaching the electromagnets by fixed stops 111'. Tractor members 108 also carry stop pins 112' limiting their motion through sleeves 111.

Electromagnets 114 are arranged with pole pieces 115 adapted to coact with armatures 109, and also with pole pieces 116 at their other extremities adapted to engage with other armatures 117.

These electromagnets are affixed to a suitable stationary support and provided with conductors 118 furnishing energy thereto.

Tractor members 108 have at one extremity hooks 160 adapted to slide over fixed pins 161 when members 108 move away from the electromagnets, but to restrain members 108 from motion towards the electromagnets unless the tractor members are pressed toward the wheel 106, so as to clear these pins. Hook members 110 are also adapted to engage fins 107 when members 108 move toward the electromagnets, but to rotate on pivots 162 when members 108 return away from the electromagnets, in such wise as to not engage fins 107, thus functioning somewhat as a ratchet and pawl, to convert bi-directional reciprocating motion into uni-directional rotation of wheel 106.

Armatures 117 are firmly affixed to suitably shaped members 119 which are capable of a translational motion through bearings 120, these latter affixed to any suitable stationary portion of the mechanism.

At the ends of the members 119 opposite the ends which bear armatures 117 are affixed suitable shaped cams 121. Movable members 108 are equipped at one end with stops 122 adapted to engage the cams 121 of members 119.

Members 119 are also provided with tractor springs 123 affixed to support blocks 124, the latter being in turn affixed to a suitable stationary point. These tractor springs serve to pull armatures 117 away from electromagnets 114 when the latter are not energized. Suitable stops 125 may also be provided to limit the motion of armatures 117 away from electromagnets 114.

Referring now to a single one of the electromagnets 114, it is provided with a pair of electrical contacts 130 carried upon suitable supporting brackets 131, one of which latter is affixed to the stationary body of the electromagnet while the other is carried by movable member 108. These contacts are so disposed as to make mutual connection with one another when armature 109 has reached its limit of motion toward pole pieces 115. Suitably disposed conductors 132, the one which connects to the movable contact being flexible, serve to afford means of electrical connection to these contacts. A similar disposition of contacts is carried by the other electromagnet 114 and the other movable member 108.

The mechanism of Fig. 11 functions as follows. When electromagnets 114 are not ener-

gized, springs 123 maintain armatures 117 against stops 125 as indicated in the case of the lower portion of Fig. 11. This causes members 119 to move to the left cams 121 so that blocks 122 will be in contact with the tapering portion of these cams. Springs 112 exerting pull on sleeves 111 cause members 108 to be pulled in such a direction that the hooks 110 at the ends thereof will no longer lie between fins 107 and therefore will not interfere with the rotation of wheels 104 and 106, as for example by the action of the corresponding hook in the upper portion of the drawing.

One electromagnet is so connected as to be excited by currents when finger tab 24 of Fig. 2 is depressed, while the other electromagnet will be excited only when finger tab 25 of Fig. 2 is depressed. Thus it will be seen that one electromagnet corresponds to a downward motion of the signal sending mechanism of Fig. 2 while the other electromagnet corresponds to an upward motion of this mechanism.

When a signal impulse arrives at one of these electromagnets the armature 117 is drawn toward the electromagnet, as shown in the upper portion of the figure, thus causing the corresponding cam 121 to move to the right and forcing, through the intermediary of stop 122, hook 110 into a position between fins 107, while sleeve 111 moves and puts spring 112 under tension. Simultaneously the holding hook 160 is released from its pin 161 and as the corresponding armature 109 is subject to attraction by this same electromagnet, it consequently moves toward the corresponding pole piece 115 thereof.

This motion causes hook 110 which is now lying between two of the fins 107 to engage one of these fins and so rotate wheels 106 and 104 to a limited extent in one direction, while spring 110' is compressed. Upon release of the current the above steps are reversed, except that hook 110 folds back and passes idly over fins 107, as previously described.

It is evident that a series of current impulses such as those derived from the transmitter of Fig. 2 will give rise to a series of movements, each through a small arc of wheels 106 and 104, thus causing pen carriage 101 to move in a vertical direction. When the signals through this electromagnet cease the restoring action of spring 112 completely disengages hook 110 from fins 107, thus leaving these fins free to be acted upon by the next set of signals.

It is evident that one electromagnet will cause a clockwise rotation of gear wheel 104, while the other will cause counter-clockwise rotation, which rotations are in turn translated through the intermediary of rack 100 into the ultimate vertical movements either in an upward or downward sense, of recording pen 102.

At the same time it will be evident that when either one of movable members 108 reaches the limit of its stroke toward electromagnets 114, contacts 130 will engage one another and thus afford means for sending an actuating electrical impulse to the paper moving mechanism hereinafter described.

The mechanism of this figure thus constitutes means for giving rise to four sequential operations by a single current impulse. First, the proper driving hook 110 is selected and engaged with the wheel 106. Second, the wheel is rotated in the desired direction. Third, the relay contacts actuate the paper feed mechanism, to be hereinafter described. Fourth, the various parts are restored to their initial condition without giving rise to any undesired movements of the actual final recording pens or paper.

Other suitable devices well known in the mechanical art, such as two oppositely working pawl and ratchet wheels upon a common shaft, may be used to secure this step by step motion in opposite directions, instead of the use of the above described mechanism.

Referring now to Fig. 12, 140 represents an electromagnet acting upon an armature 141 which is normally held away from the magnet by tensile springs 142 affixed at their extremities to suitable stationary supports 143. Armature 141 has affixed to it a driving rod 144 operating through a bearing 144', which communicates its motion through a link reversing motion indicated at 145 to an indent actuating member 146, which engages the teeth 147 upon the periphery of wheel 148. Teeth 147 are arranged at such angles in relation to the indent actuating member 146 that a reciprocating motion of member 146 will give an intermittent but unidirectional motion to wheel 148.

Wheel 148 may be affixed to the roll (not shown) which feeds the paper horizontally beneath the recording pens, or alternatively to means for moving the pen mechanism itself horizontally along the paper.

In the operation of the mechanism of Fig. 12, electromagnet 140 is excited when an impulse from the central station has caused the driving mechanism of Fig. 11 to complete one working stroke, thus closing relay contacts 130. The excitation of magnet 140 causes armature 141 to move toward it. This movement communicated in turn through members 144 and 145 causes member 146 to move over teeth 147 of wheel 148, but without causing any motion of the wheel itself. The release of the armature 141 by the breaking of the electrical circuit actuating magnet 140 allows retractile springs 142 to function and return armature to its original position. While armature 141 is returning to position, its movement is communicated through members 144, 145 and 146 to the teeth 147 on wheel 148, which latter is thus rotated a distance proportional to the play of armature 141. The record paper is thus given a horizontal motion for a uniform distance, each time that the mechanism of Fig. 11 moves one stroke.

In certain cases, as hereinafter described, it may be desirable that the paper driving mechanism do not function for each stroke of the mechanism of Fig. 11. Accordingly a push button switch (301 in Fig. 13) is so connected that the circuit actuating electromagnet 140 may be broken at the central station, when the operator so desires. This will allow the mechanism of Fig. 11 to function without the simultaneous functioning of the mechanism of Fig. 12.

Fig. 13 illustrates one suitable circuit for connecting together the various mechanisms located at the central station and at the subscriber's station. The portion of this schematic diagram to the left of the dotted connecting wires represents the portion of the mechanism which may be conveniently placed at the central station, while the portion at the right represents the mechanisms conveniently placed at the subscriber's station. However, many pieces of mechanism, especially batteries and similar power sources may be more conveniently placed entirely at the central station. As the positioning of these various parts forms no integral por-

tion of my invention, such variations are not herein described.

The source of energy for the central station is represented schematically as a battery at **302**, but may be, of course, any other convenient form of electrical energy. Other batteries **303** and **304** actuate local circuits at the subscriber's station.

It may be possible by means well known in the electrical art to effectuate the power supply to these local circuits by energy suitably branched off or derived through transforming mechanism from the single source of energy supply **302**.

At the extreme left of Fig. 13 is seen the impulse producing device of Figs. 2, 3 and 4. The essential electrical parts of this mechanism bear the same numbers as in the case of these figures and can be readily identified by referring thereto. Push button switch **301**, referred to in the description of Fig. 12, is of the normally closed type and is connected by conductors **305** and **306** to the subscriber's station, so as to allow the breaking of the circuit energizing electromagnet **140**, when the button **301** is depressed.

The depression of button **301** allows the operator to elevate or lower the price pen without any motion of the paper. This may be desirable when the price undergoes an alteration of value giving rise to more than one impulse, i. e., an alteration of more than one unit of price, at one instant without the lapse of a time interval which would, were it not for the provision of this button, cause more than a single horizontal line.

At the central station are also indicated buttons **55** which represent two of the plurality of buttons indicated in Fig. 5. Wire **53** connects the common return of these buttons to another power supply indicated schematically at **307** as a battery. This power supply may be identical with power supply **302**, **303** and **304**, or all these power supplies may be branched off or derived from a common circuit as above described.

From battery **307**, conductor **308** leads to the subscriber's station and functions as a common return wire for all the circuits actuating the electromagnets **64** thereat. It is to be understood, of course, that a number of buttons **55** are necessary in order that a series of points may be recorded by the volume pen at the recording instrument, since each button controls only one of the movable members **66** of Figs. 7, 8 and 9. A number of conductors **52** must also be employed, one for each button used. A common return wire **309** serves to furnish the return connection from the subscriber's station to the power supply **302**.

The subscriber's station is indicated at the right portion of Fig. 13, the mechanism moving the price pen being indicated at the upper portion and the mechanism moving the volume pen at the lower portion. The essential electrical parts bear numbers corresponding to those affixed to them in the previous detailed figures, and their operation has been previously described in connection with these figures.

It is understood that other suitable electrical circuits may be substituted for those herein shown, to accomplish the same ultimate results in producing the charts of my invention. For example, the dotted lines may represent not only physical conductors, but may be electrical "channels," either upon wires or of a radiant character in space.

The energy supply of pen driving motor **76** is not indicated, as it may be any local source suitable for the purpose, or may be supplied from the central station over appropriate channels, which may also be used to carry the record actuating signals by means well known in the electrical art.

While I have shown for the sake of clarity the important circuits of this figure as separate wires, it is apparent that one skilled in the art can combine some of these conductors or channels, in the interest of economy, without avoiding the inventive ideas underlying the circuits herein shown.

In Fig. 14 is shown a record chart **404** where the horizontal dimension represents uniform time intervals. This may be secured in the well known manner of making such record charts, either by a uniform motion of the paper beneath the recording styli or else by a uniform motion of the styli themselves. Mechanisms for securing such motion at a uniform velocity are well known and may include such devices as clockwork or constant speed driving mechanisms, actuated by electricity or other convenient motive power.

The pen marking the upper record line **401** of Fig. 14 is actuated in a vertical direction in accordance with the instantaneous average price of a selected group of commodities. This average is automatically obtained by means hereinafter described. The pen marking this price curve moves only when the average price changes by a certain minimal and pre-selected amount.

The motion of the pen in a vertical direction is preferably sufficiently rapid so that relative horizontal motion between pen and record sheet is negligible during such movement. This brings about the result that the vertical lines of the upper record are substantially perpendicular to the horizontal lines thereof.

The record line **401** may use the same horizontal scale as that of the volume line **402**, described below. Its vertical scale may be upon the paper or may be as shown on a ribbon **407**, adjustable by means such as those indicated in the case of ribbon scale **22** of Fig. 2.

The mechanism moving this pen may be substantially identical with that of Fig. 11, with the omission of relay contacts **130**, since the paper now moves uniformly and independently of the movements of this pen.

Record lines **402** represent by their vertical dimensions the relative total volume of sales of the group of commodities whose average price level is represented by record line **401**. The volume lines may be recorded by mechanism similar to that shown in Figs. 7, 8, 9 and 10, and may be controlled by a keyboard located at the central station and similar to that illustrated in Figs. 5 and 6.

Lines **402** may be made in this case at uniform time intervals, so that an observer of this chart can tell the volume of trading which has occurred in the commodities represented thereupon at short intervals of time, such as one minute.

The indications representing time elapsed may be marked upon a scale **408** acting as a portion of the frame surrounding the visible portion of chart paper **404**. This scale will then screen the undesired portion of lines **402**, such as those parts below zero and where the pen may drag horizontally as shown at **405**.

The vertical scale **406** may also conveniently be upon a movable ribbon, so that it may be set to suit different units or values, as in the case of the price scale, or it may be upon the paper itself.

Lines 402 may also have a scale which is graduated so as to read the average volume. Such a scale may have its indications in values equal to the total volume divided by the number of stocks in the group to be averaged.

The volume record lines 403, indicated by dotted lines, may be in practice continuous lines with some distinguishing characteristic such as color, to allow them to be more readily differentiated from lines 402. These record lines may be made by a mechanism similar to that employed for actuating the recording stylus which gives the record lines 402. Record lines 403 are made only at the instant when the average price of the selected group of commodities undergoes the preselected minimal change which causes the stylus recording the price line to move in a vertical direction. The signals actuating this stylus may be driven by current from a keyboard such as that of Figs. 5 and 6.

It will thus be seen that the record chart of Fig. 14 allows the observer, at a glance, to see the average price of the group of commodities, the total sales in each short unit of time of these commodities, and the total sales elapsing between each change of price in these commodities.

It is, of course, possible to omit any of these records which do not interest the particular observer desiring such a record chart. Furthermore, it is possible upon this same record chart to add to the record additional lines denoting any other desired changes, provided that such records are plotted upon a time scale uniform with that of the other records above described.

For example, an additional record line showing the fluctuations in price and/or the volume trading in a given single commodity may be recorded upon this same sheet, and differentiated from the records of the group changes by any suitable means, such as the use of vari-colored inks or the like, for the respective recording styli.

The frame surrounding the record chart of Fig. 14 is supplied in both the vertical and horizontal dimension with a plurality of scales suitable for the values recorded in the respective dimensions as above mentioned. These scales may be of a shifting character, in order to increase the flexibility of the apparatus, as explained in connection with the record chart of Fig. 1.

Referring now to Figs. 15, 16 and 17, there is represented in these figures the essential and novel portions of an electro mechanical device for obtaining the algebraic summation of changes occurring in the prices of a predetermined number of commodities such as stocks, bonds, grains and the like. This algebraic summation is expressed in numerals representing the average price of this selected group of stocks.

This electro mechanical device, termed for convenience averaging device, also operates to transmit electrical signals to a recording pen, whenever the numerical average obtained by the device undergoes an alteration of value.

A further possible function of this averaging device is to allow the ready transformation of values expressed in vulgar fractions to those expressed decimally, or vice versa.

Fig. 15, which illustrates an elevation of one end of this averaging device, shows two solenoids 510 and 511, acting upon plunger type armatures 512 and 513 respectively. These solenoids may be of any convenient type and are illustrated as having insulating washers 514 at their ends and a hollow insulating lining 515, lining the hollow substantially cylindrical space which is situated at the center of such solenoid. Through this hollow center space ply two shafts 516 and 517 capable of longitudinal motion through bearings 518 and 519 at their upper ends and through corresponding bearings 520 and 521 at their lower ends. The plunger type armatures 512 and 513 are firmly affixed to these shafts and the longitudinal motion of the latter may be so limited by suitable stops (not shown) that armatures 512 and 513 ply between the positions shown respectively at the left and right sides of this picture. Solenoids 510 and 511 are supplied with signal-bearing energy through wires 522 and 523 as hereinafter described.

A rotating wheel 524 rotates upon a suitable shaft 525 and is maintained in any one of a number of suitable angular positions by means of a ratchet 526, also upon shaft 525 and with which a light spring pawl 527 coacts. This pawl may be fastened at one end to a suitable fixed point 528.

Wheel 524 is supplied at its peripheral surface with fins 529 projecting radially therefrom. These fins correspond in number to a factor obtained by dividing the total number of stocks in the preselected group by the conversion factor, if any be used, for changing the unit used in recording the price change of one of such stocks from one system of notation to another. For example, in the case indicated there are eight such fins, 529, and if ten stocks constitute the group to be recorded, and one of such stocks undergoes a change of price of ⅛ of a unit, the wheel 524, of which wheel 530 is a fixed part, will serve, in conjunction with wheel 551 of which wheel 550 is a fixed part, to convert the vulgar fraction ⅛ into its equivalent decimal 0.125. This conversion takes place by virtue of the wheel 524 making one revolution in eight steps, whereas the wheel 551 makes one revolution in 80 steps of wheel 524; the gear ratio between said wheels 524 and 551 being ten to one. In other words, turning of wheel 524 through ten steps corresponds to ⅛ rotation of wheel 551 or 0.125. This system may conveniently be employed for expressing averages of ten stocks, since the eight fins of wheel 524 correspond to the vulgar fraction customarily employed in indicating change of price of a stock. It is to be understood that, if the same unit be employed in expressing price changes and average value, the numerals upon wheel 530 and the fins upon wheel 524 may be identical in number.

Referring again to Fig. 15, shafts 516 and 517 carry pins 531 and 532 while bearings 520 and 521 are also supplied with fixed pins 533 and 534. Between the two pins on each shaft and its respective bearing there is fastened a retractile spring indicated on the left side at 535 in its expanded position, and at the right side at 536 in its contracted position. These springs serve to maintain shafts 516 and 517 at the lowest point of their longitudinal movement, when electromagnets 510 and 511 are not excited. Shafts 516 and 517 also bear pawl members 537 and 538, respectively. Pawl 537 is so arranged by means well known in the mechanical art so that it can rotate upon shaft 516 through a limited arc in a counter clockwise direction but is prevented by stop 539 from moving in a clockwise direction to an angular position beyond that indicated in the drawings. Pawl 538 functions in exactly the opposite fashion by means including stop 540.

Wheel 524 is so located in respect to the two shafts 516 and 517 and to their pawl members 537 and 538, that when the electromagnet 511

attracts its armature, and so causes an upward motion of its pawl member, it will engage a fin located at the position indicated by numeral **541** and cause it to move upwardly to the position indicated by numeral **542**, thus rotating wheel **524** through a limited number of degrees in a counter clockwise direction.

When electromagnet **511** ceases to be excited, retractile spring **536** will cause shaft **517** to return to its lowest position of longitudinal traverse and pawl **538** will be correspondingly returned to the position indicated in this figure. While pawl **538** is moving downward, it rotates upon shaft **517** in such fashion as to slide by any fin upon wheel **524** with which it may come in contact, and the light pawl and ratchet arrangement indicated at **526** and **527** serves to prevent wheel **524** from rotating under the influence of such sliding engagement. The electromagnet, shaft and pawl assembly indicated at the left side of Fig. 15 serves in corresponding fashion to move the fin connected at **543** to the position indicated at **544** when the electromagnet **510** is excited.

It will thus be seen that the two electromagnets of this figure act respectively to impart a clockwise or a counter clockwise motion to wheel **524** over an arc determined by the angular displacement of fins **529** situated upon this wheel, and that this motion is of a step by step character and cumulative in its result, giving an algebraic summation of the positive and negative impulses reaching it.

Referring now to Fig. 17 certain of the parts already indicated are apparent at the right hand portion in this figure. The various numbered wheels indicated in this figure are arranged in a fashion commonly employed to constitute what is termed a numbering head. This numbering head is a type of mechanism well known in the mechanical art and employed in many places, such as in the odometric recording mechanism commonly associated with tachometers employed upon automobiles and the like. Such numbering head mechanisms so operate that one numbered wheel thereof upon making a complete turn causes its adjacent wheel to move the same fractional portion of a complete turn as is indicated by the total number of digits displayed upon its surface. This insures the display at all times of a complete series of digits, each one being wholly displayed at any one instant, with the exception of the digits upon the primary driving wheel, which is usually at the right hand extremity of the series of wheels and which may be fractionally exposed. Such mechanisms very often employ a decimal system of notation, and accordingly may rotate in the ratio of 10 to 1 with respect to each other.

In Fig. 17, the primary driving wheel is that indicated at **530**, which is firmly fixed to wheel **524** so as to be rotated therewith when the latter is turned by the mechanisms of Fig. 15, some of which are omitted from Fig. 17, for purposes of clarity.

The next numerically adjacent wheel is indicated at **550** and has firmly affixed to it so as to rotate therewith, a wheel **551** bearing upon its periphery contact fins **552** extending radially therefrom. Other wheels indicated at **553** and **554** are not associated with any fin bearing wheels but merely serve as numerical indicators for each succeeding decimal place. The shaft **525** serves as a bearing for all the numerical and fin bearing wheels of this mechanism.

Referring now also to Fig. 16, wheel **551** may be made of insulating material through which project radial fins **552** made of a suitable conducting material such as brass. These fins project outwardly from a conducting ring **558** located concentrically with the central shaft **525**, but insulated therefrom by a suitable bushing **560** made of insulating material. Conducting ring **558** is extended laterally beyond fins **552** and brush **561** rubs thereupon, being supplied with electrical energy through a suitable conductor **562**.

Fins **552** serve to engage conducting pieces **573** located upon the two opposite sides of an insulating body **574** rotating through a limited arc about a suitable fixed pin **575** at one end.

Body **574** is normally kept in a vertical position by suitable cooperating springs **576** connected thereto at one end of both and fastened at their other ends to fixed pins **577**. Wires **578** are connected by suitable flexible leads with conducting strips **573**.

In the operation of the signal transmitting mechanism indicated in Figs. 16 and 17, fins **552** come in contact with either one of the contact strips **573** in accordance with the direction that wheel **551** is rotated, thus closing a circuit through the corresponding conductor **578**. As wheel **551** continues to rotate, insulating body **574** will swing around pin **575** and allow fin **552** to pass by the same. Springs **576** will then restore insulating body **574** to its vertical position between fins **552**. It is evident then, that continued rotation of wheel **551** in either direction will send a series of step by step impulses over the corresponding conductor **578**. Conductors **578** are connected as hereinafter described, with electromagnetic devices operating upon an average price recording pen.

The electromagnets of Fig. 15 receive step by step impulses from the plurality of impulses with which they are associated, and since such impulses produce identical results in the apparatus of Fig. 15, they will serve to operate upon the numbering head of Fig. 17 in an identical fashion. Thus a series of increases in the price of any one stock or of a number of different ones will cause the continued rotation of drive wheel **530** in one direction.

When such rotation has totaled a complete single turn of this wheel, the numbering head mechanism will cause wheel **551** to rotate to an angular extent determined by the gear ratio employed to couple the two wheels, in this case $\frac{1}{10}$ of one complete revolution, thus sending one signal over a conductor **578** to the average pen recording mechanism. A series of decreases in the price of any one or a number of the stocks will eventuate in the sending of a single signal over the other conductor **578** to the average pen.

In case that more or less than ten stocks are being averaged, or in the case that either the vulgar or the decimal system of notation is employed throughout the number of fins and/or the gear ratios of the numbering head will be altered in accordance with the principles above outlined.

It is evident that wheels **530** and **550** are merely convenient means of indicating the angular positions of the respective fin-bearing wheels affixed to them. Acordingly they may be omitted and the indicating numerals placed upon the fin-bearing wheels themselves.

The diagrammatic circuit of Fig. 18 illustrates at the left hand side a portion of the apparatus which may be employed at the central station to transmit signals over the channels indicated by

the dotted section of the wires to the recording apparatus of which only a portion is indicated at the right hand of this figure.

At 51 is indicated a button, closing contacts 55 and 56 which send current from battery 307 through a conductor 52 to the subscriber's station. A second button of this type is also indicated with another conductor 52 leading to the subscriber's station. A common wire 308 serves as a return for the individual wires 52 leading to each button. At 65 are indicated the wires at the subscriber's station which are in connection over the communication channels with wires 52 and 308.

Conductors 65 may be connected to volume recording apparatus at the subscriber's station, of substantially the same type as indicated in Fig. 13, and accordingly this apparatus has not been shown in Fig. 18, in order to avoid unnecessary duplication. As in the case of Fig. 13, buttons 51 are provided, to a number corresponding to the total number of discrete values of volume which are to be indicated, and each button is provided with its individual wire 52 leading to a separate electromagnet at the subscriber's station.

Referring now to the upper left hand portion of Fig. 18, there is seen a step by step signal producing apparatus substantially corresponding to that indicated in Fig. 13. This also incorporates a slider 38 contacting with buttons 40 and a circuit selector device, including a common contact member 31 and two individual contact members 36 and 37. Below this first impulse transmitter is shown a second such transmitter having a plurality of contacts 640 mounted upon a suitable insulating strip 639 and connected together by conductor 640' to switch contact 641, which latter will in turn be connected to fixed contact 644 when switch handle 643 is closed.

A movable sliding contact 638 plays along strip 639 over contacts 640 and is connected to a common contact making member 631 cooperating with two separate contact members 636 and 637 to select a desired circuit.

At the lower left hand corner of this diagram is indicated still a third contact making device similar to those indicated above. In this case contacts 740, connected by wire 740' through contact 741 and switch blade 743 to fixed contact 744 are shown. A movable slider 738 is connected to a contact member 731 which may be selectively engaged with either one of the two contacts 736 and 737.

These above described three separate impulse transmitters are representative of a series of such transmitters, one of which is provided for each stock of which record is to be kept and which is to enter into the final average obtained by the averaging mechanism previously described.

In the case of all these impulse transmitters the fixed contacts of the respective switches are connected to a common lead 700, and the circuit selecting contacts 36, 37, 636, 637, etc. are also connected to common lead wires 734 and 735 which terminate respectively in the two solenoids 510 and 511.

These solenoids are those indicated in Fig. 15. The armature plungers 512 and 513 which cooperate with these solenoids are diagrammatically indicated. The return circuit of both these solenoids is made through conductor 701 to battery 702, whose other terminal is connected to the common return wire 700.

It can thus be seen that any one of the three impulse senders above described, or any one of an indefinite number of such transmitters, similarly connected to the common wires 700, 735 and 734, can be operated at a given instant, and that the operation of any individual transmitter will send impulses through solenoids 510 or 511 exactly similar to the impulses derived from the operation of any other one of the transmitters. Thus a rise in the stock indicated upon any of the transmitters will produce an excitation of the solenoid 511, which operates the averaging mechanism in a positive direction, while a fall of price of any stock indicated by any transmitter will likewise produce an identical signal in the solenoid 510, designed to operate the averaging mechanism in a negative direction.

The averaging mechanism, whose construction and operation has been indicated in Figs. 15, 16 and 17, is here indicated diagrammatically by the box labeled "Average box." The wheels bearing fins, the recording and the averaging mechanisms contained therein are mechanically actuated by solenoid armatures 512 and 513.

The contact making mechanism of the signal producing device described in Figs. 16 and 17 is indicated within this average box and bears reference numerals corresponding to those of Fig. 15.

Conductors 578 are connected to individual communication channels, and convey respectively the impulses which give rise to an upward and to a downward motion of the average price recording pen at the subscriber's station. A common return conductor 562 leads to one side of a battery 703. The other side of this battery is connected by conductor 709 to the subscriber's station and serves as a common return from the recording mechanism thereat.

Conductors 578 are connected at the other extremity of their respective communication channels to conductors 718 which convey the current therefrom to electromagnets 714. These electromagnets derive their common return through conductor 709', connected through another channel to conductor 709 at the central station.

Electromagnets 714 operate in substantially the same fashion as the electromagnets 114 indicated in Fig. 13. These electromagnets operate upon mechanisms, as shown in Fig. 11, giving rise to a step by step vertical motion of the price recording pen. However in this case, auxiliary relay contacts 130, together with their mechanical supporting parts and attached electrical conductors, are no longer needed and may be omitted.

These contacts served to actuate the mechanism of Fig. 12 which determined the relative horizontal motion between the recording pen and the paper. In the case of the recording pen actuated by electromagnet 714 of Fig. 18, a continuous relative motion between this pen and paper is secured by means such as clockwork, an electric motor, or the like, and accordingly the mechanism of Fig. 12 is in this case no longer needed.

As in the case of Fig. 13 it is to be seen that Fig. 18 is for the sake of clarity drawn with each individual part as a separate unit. It is to be understood that many of these individual parts can be combined into a single unitary structure. For example, the various batteries shown may be replaced by branch circuits derived through suitable intermediary means from a common energy source, which may be a dynamo or other suitable electrical energy producing means. Likewise certain of the communication channels between the central station and the subscriber's station may be combined with one another. Such communi-

cation channels also may be of a discrete electrical nature, although of a common physical nature, such as carrier channels of various frequencies upon a single conductor, or radiated through space.

Many variations of the records indicated in Fig. 1 and Fig. 14 are possible. For example, the volume pen which produces lines 21 may be arranged without means for automatically returning it to zero after each indication.

In this case the pen will produce horizontal lines upon the record chart between each signal, and will produce a stepped record similar to that indicated at 20. In the case of this stepped type of record each successive vertical portion will indicate by its length the volume sold since the previous vertical line and the overall point reached by the vertical line last drawn will indicate the summation of all such volume sales.

Likewise in the case of Fig. 14 the volume record pens producing the continuous and/or dotted lines may be arranged without an automatic zero return. They will then produce a record of the stepped form and may have zero return release electromagnets in a fashion such as described in the foregoing paragraph.

Still other combinations of certain elements of the charts of Figs. 1 and 14 are possible; for example, the chart of Fig. 14, instead of moving uniformly in a horizontal direction, may be impelled by a mechanism such as that of Fig. 12, actuated through auxiliary contacts such as those indicated by the numerals 130 upon the line drawing device shown in Fig. 11, and the volume record may be made only when a price change occurs.

This assembly of devices will give records of the general type of those shown in Fig. 1, but the price line will represent the average price of a selected group of stocks, instead of the price of a single stock and the volume line may then represent either the total or the average volume of sales of such selected group, as explained in connection with the description of Fig. 14.

Other combinations of the various mechanisms above described may be made, to secure different types of record charts, in accordance with the data required by the users of such charts. The electrical and mechanical combinations needed to secure such combination records may be readily devised by those skilled in such arts, in the light of the foregoing disclosures and explanations.

While I have described certain electrical and mechanical devices for producing the charts or graphical records of my invention, other similar or functionally equivalent mechanisms may be substituted for those hereinbefore shown, to indicate, transmit and/or produce such records, without thereby transcending the limits of my invention.

Many other changes and modifications of my invention will be apparent to those skilled in the arts pertaining thereto and I am not limited in the scope of my invention otherwise than indicated by the hereunto appended claims.

I claim:

1. Apparatus of the character described comprising means for causing values to be averaged, a remote receiving means comprising a recorder, and electrical transmitting means operable under control of the first mentioned means in response to a predetermined amount of change in the average for causing operation of said recording means.

2. Apparatus of the character described comprising means for causing values to be averaged, a remote receiver comprising a recorder, electric transmitting means controlled by the first mentioned means and connected to said receiver, said transmitting means comprising a circuit controlling element and means for operating said element only in response to a change in said average in excess of a predetermined amount.

3. Apparatus of the character described, comprising means for averaging values of items of a group, transmitting means for operating said averaging means in accordance with a change in value of any of said items and causing said averaging means to indicate the new average of the values of the items, a remote receiver, electrical means controlled by said operating means for sending electric signals to said receiver whenever a change in the average value exceeds a predetermined amount, and means at said receiver responsive to said signals for causing the production of a graphic record showing said averages.

4. Apparatus of the character described, comprising means operable in accordance with different values, means including electrical transmitting means under the control of the first mentioned means for transmitting changes in averages of said values when said average value changes are in excess of a predetermined amount, the second mentioned means also including means for preserving and accumulating average value changes of less than said predetermined amount, and a remote receiving means comprising a recorder controlled by said transmitting means to produce a graphic record of the transmitted average value changes.

5. Apparatus of the character described, comprising means for causing values to be averaged, a remote receiving means comprising a recorder, means controlled by the first mentioned means for transmitting to said receiving means electrical impulses corresponding in number to the number of units of change in the aforesaid average, and means responsive to each of said impulses for actuating said recorder to produce a corresponding record of the change in average.

6. Apparatus of the character described including a transmitter for sending electrical signals corresponding with different values, means responsive to said signals for averaging said values, means responsive to said last named means for electrically transmitting other electrical signals indicating changes in said average, and recording means at a distance actuated by said other signals and recording said average changes.

7. In a system of recording, a transmitter for sending electrical impulses each representing an increment of value, a device responsive to said impulses for calculating the average value of said impulses with respect to a predetermined base, electrical means controlled by said device for transmitting other impulses, each representing a predetermined change in average value to a distant point, and means located at said distant point and responsive to said other impulses, for recording said changes in values.

8. In a system of recording, means operable in correspondence with variable values, a device controlled by said means for calculating the average of said values with respect to a predetermined base, electrical means controlled by the first mentioned means for transmitting to a distant point impulses each representing a predetermined change in said average, and means located at said distant point and responsive to

said impulses for recording said changes in average.

9. Apparatus of the character described, including manually actuated means settable in accordance with values, means controlled by said manually actuated means for averaging said values, means actuated by said averaging means for transmitting electrical signals, and means for translating said signals into a graphic record of said averages.

10. Apparatus of the character described including manually actuated means settable in accordance with values, means controlled by said manually actuated means for transmitting electrical signals, means responsive to said signals for averaging said values, means actuated by said averaging means for transmitting other electrical signals, and means for translating the last mentioned signals into a graphic record of said averages.

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