Oct. 8, 1946. CHUNG-CHIN KAO 2,408,780

METEOROLOGICAL RECORDING METHOD AND APPARATUS

Filed April 5, 1944 10 Sheets-Sheet 1

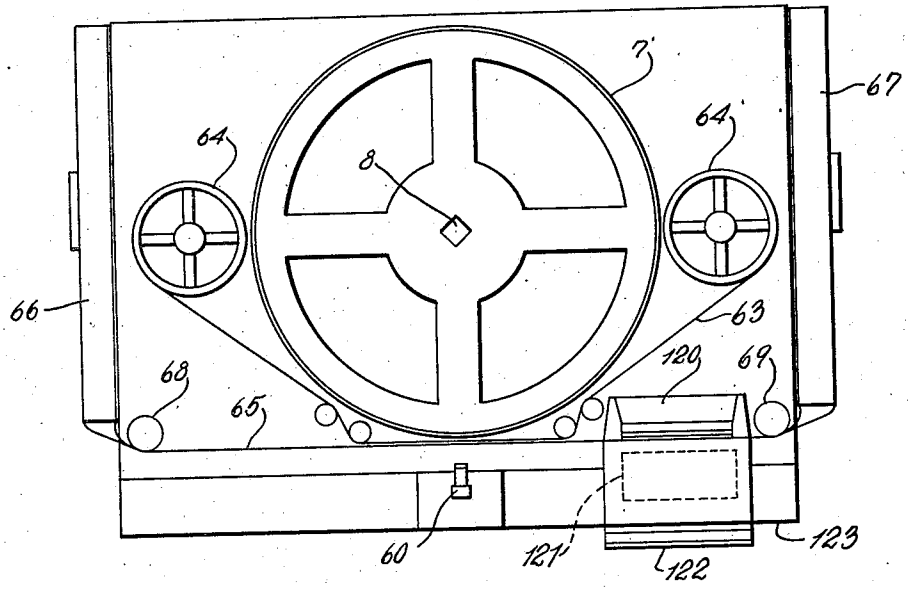


Fig. 1.

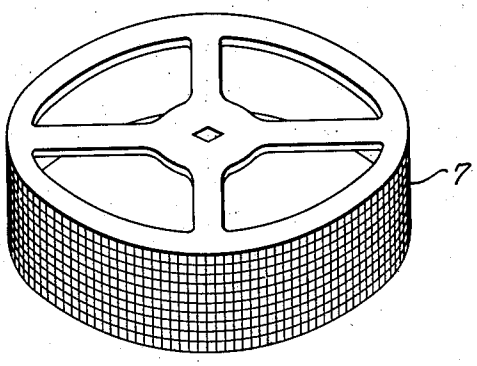


Fig. 3.

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Oct. 8, 1946. CHUNG-CHIN KAO 2,408,780

METEOROLOGICAL RECORDING METHOD AND APPARATUS

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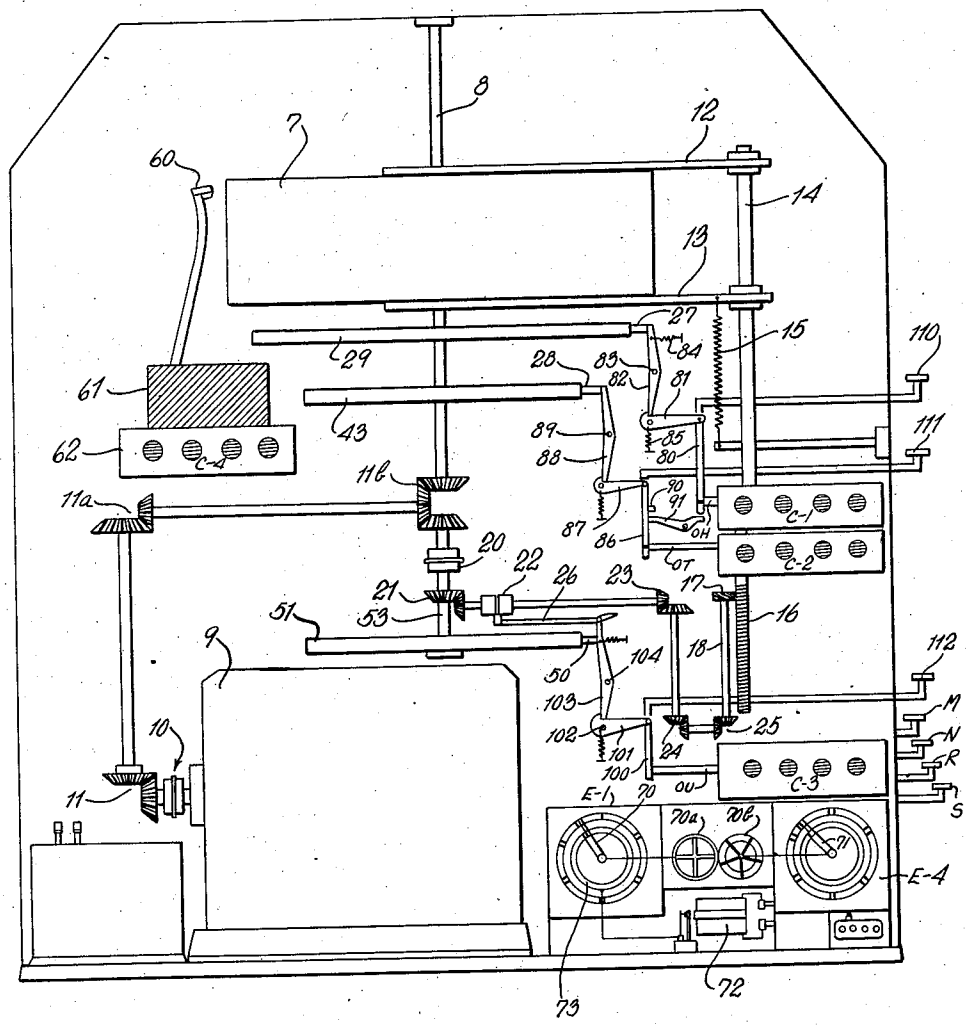


Fig. 2.

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Oct. 8, 1946. CHUNG-CHIN KAO 2,408,780

METEOROLOGICAL RECORDING METHOD AND APPARATUS

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Fig. 4.

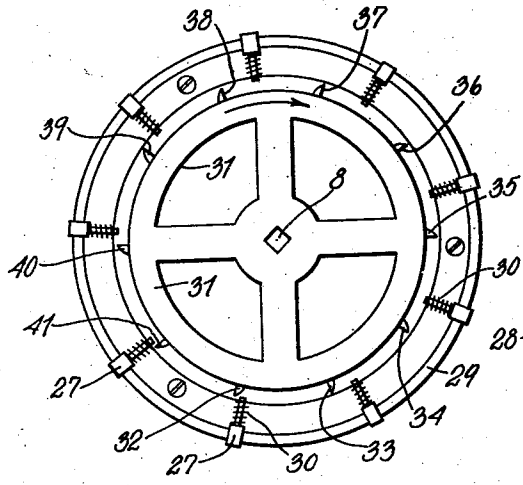


Fig. 5.

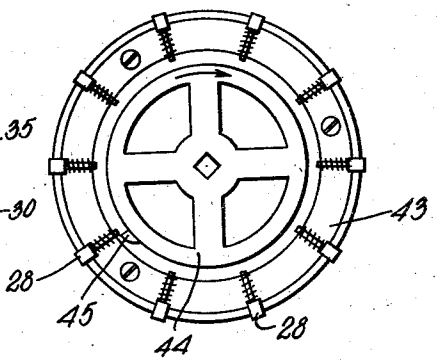


Fig. 6.

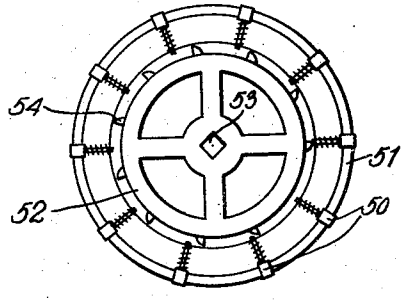
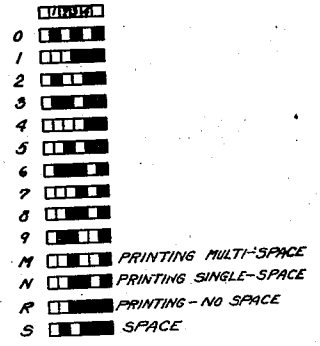


Fig. 8.



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Oct. 8, 1946. CHUNG-CHIN KAO 2,408,780

METEOROLOGICAL RECORDING METHOD AND APPARATUS

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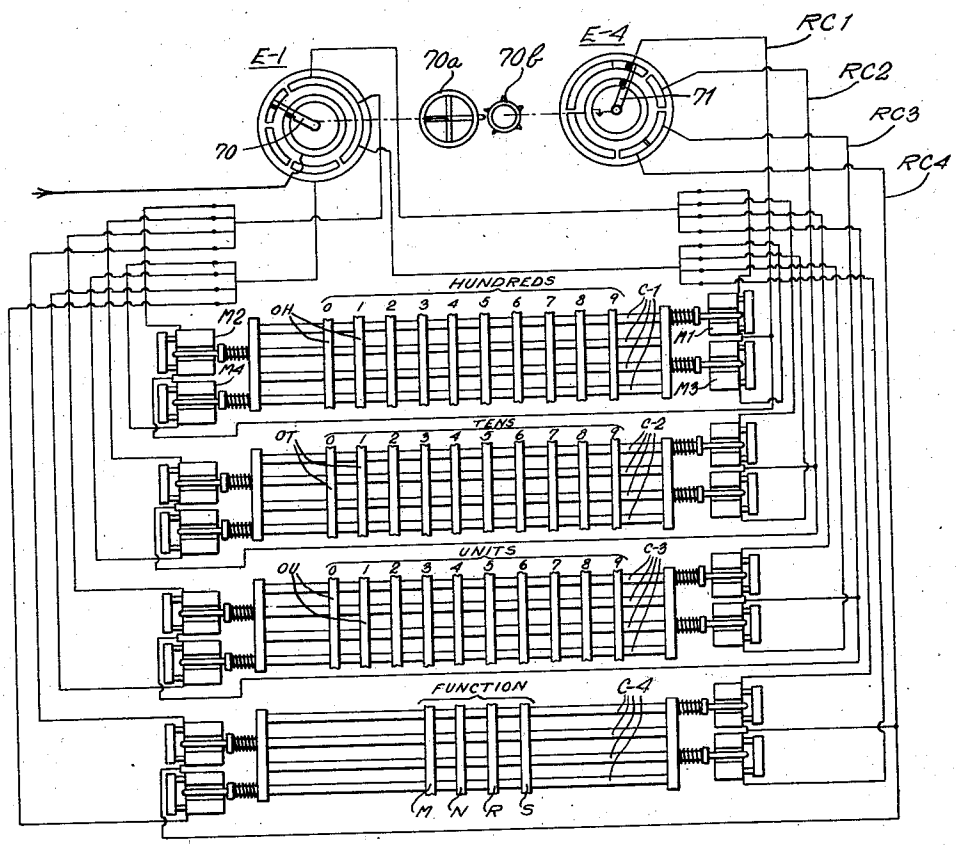


Fig. 2.

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METEOROLOGICAL RECORDING METHOD AND APPARATUS

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Fig. 9.

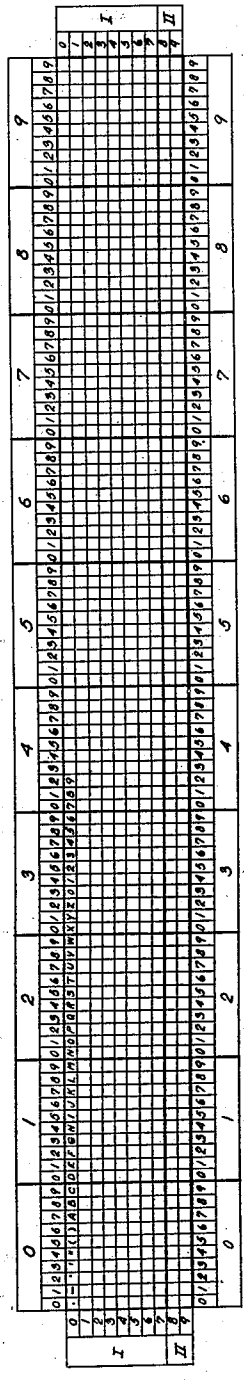
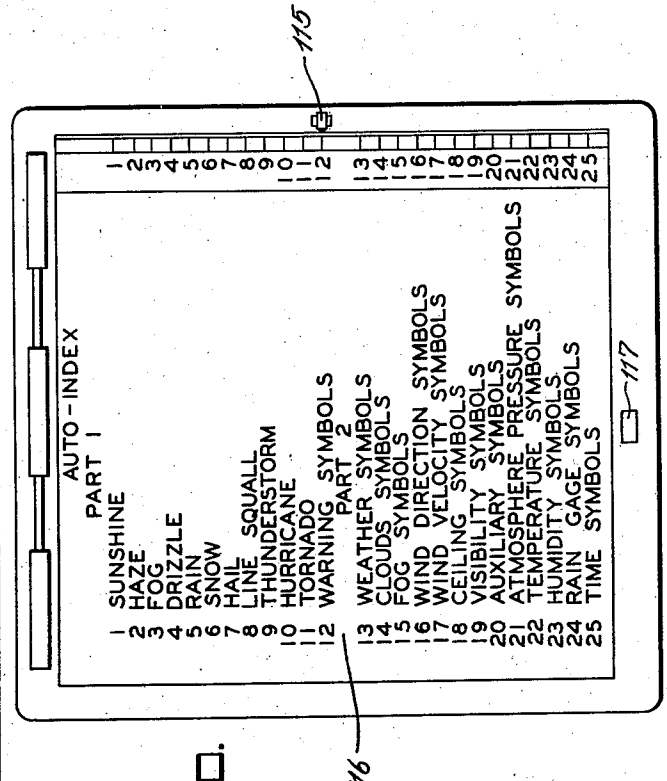


Fig. 10.



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METEOROLOGICAL RECORDING METHOD AND APPARATUS

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Fig. 11.

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METEOROLOGICAL RECORDING METHOD AND APPARATUS

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• 000	— 001	° 002	' 003	" 004
(005	) 006	A 007	B 008	C 009
D 010	E 011	F 012	G 013	H 014
I 015	J 016	K 017	L 018	M 019
N 020	O 021	P 022	Q 023	R 024
S 025	T 026	U 027	V 028	W 029
X 030	Y 031	Z 032	0 033	1 034
2 035	3 036	4 037	5 038	6 039
7 040	8 041	9 042		

Fig. 12.

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METEOROLOGICAL RECORDING METHOD AND APPARATUS

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		INDEX							A-2
WEATHER	A-2	HAZE							
CLOUDS	B-4	¾ COVERED							
WIND VELOCITY MPH.	VISIBILITY	WIND DIRECTION N.	NE.	E.	SE.	S.	SW.	W.	NW.
1 1-7	NORMAL	171	175	179	183	187	191	195	199
2 8-18	"	172	176	180	184	188	192	196	200
3 19-31	"	173	177	181	185	189	193	197	201
4 32-38	"	174	178	182	186	190	194	198	202
1 1-7	POOR	203	207	211	215	219	223	227	231
2 8-18		204	208	212	216	220	224	228	232
3 19-31		205	209	213	217	221	225	229	233
4 32-38		206	210	214	218	222	226	230	234
CLOUDS	B-5								
1 1-7	NORMAL	235	239	243	247	251	255	259	263
2 8-18	"	236	240	244	248	252	256	260	264
3 19-31	"	237	241	245	249	253	257	261	265
4 32-38	"	238	242	246	250	254	258	262	266
1 8-18	POOR	267	271	275	279	283	287	291	295
2 19-31	"	268	272	276	280	284	288	292	296
3 32-38	"	269	273	277	281	285	289	293	297
4 39-46	"	270	274	278	282	286	290	294	298

Fig. 13.

EXAMPLE OF WEATHER REPORT MESSAGE
STATION NO. AC-8-H
TIME 2:30 PM
WEATHER CONDITION:-
1. RAINING
2. CLOUDS:
   a. CUMULUS
   b. ALL COVERED
3. WIND DIRECTION - E-NE
4. WIND VELOCITY:
   25-31 MPH.
5. CEILING - 2000 FT.
6. VISIBILITY - ½ MILE
7. ATMOSPHERE PRESSURE - 31
8. MOVEMENT OF BAROMETER DURING PAST THREE HOURS:
   LOW AND FALLING RAPIDLY
9. TEMPERATURE - 46.75 F
10. HUMIDITY - 55
11. RAIN GAGE - 0.14 INCHES
12. TIME 2:30

Fig. 14.

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METEOROLOGICAL RECORDING METHOD AND APPARATUS

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TRANSMITTING CODE - PERFORATED TAPE:

007n 009n 001n 041n 001n 014n 805n 824n 862n 838n
880n 888n 898n 931r 908n 938n 947r 913n 924r 912n
960r 912n 966n 918r 911n 977r 993n 022n 019m

Fig. 15.

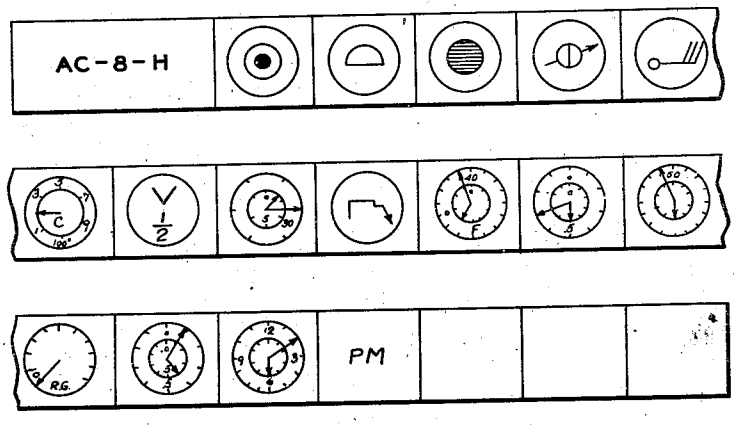


Fig. 16.

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Oct. 8, 1946. CHUNG-CHIN KAO 2,408,780

METEOROLOGICAL RECORDING METHOD AND APPARATUS

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Fig. 12.

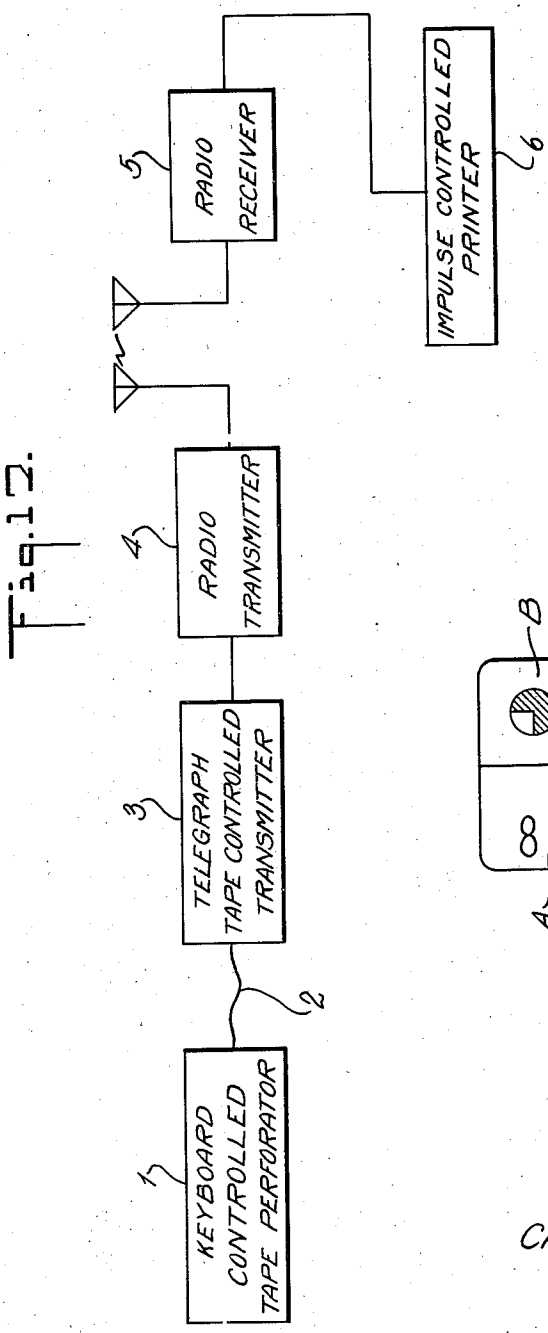
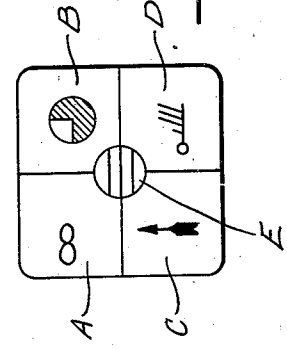


Fig. 13.



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Patented Oct. 8, 1946

2,408,780

UNITED STATES PATENT OFFICE

2,408,780

METEOROLOGICAL RECORDING METHOD AND APPARATUS

Chung-Chin Kao, New York, N. Y.

Application April 5, 1944, Serial No. 529,690

18 Claims. (Cl. 178—34)

1

This invention relates to recording devices and more particularly to improved methods and devices for recording either locally or at a distance, meteorological data and information.

A principal object of the invention is to provide a keyboard-controlled machine for printing specially coded composite characters representing groups of meteorological information and the like.

Another principal object relates to a printing machine for printing directly at each printing impression, a composite character representing groups of meteorological data.

Another principal object relates to a printing machine having a large number of type faces each representing coded combinations of meteorological data, together with selective mechanisms for presenting any desired one of the type faces to a printing point.

Another principal object is to provide a method of tele-transmission and reproduction of meteorological data whereby a considerable saving in transmission line time is effected.

Another principal object is to provide a decoding machine for translating numerical code indicia into other printed intelligence, such for example as weather data, navigational data, meteorological conditions and the like.

A feature of the invention relates to a keyboard-controlled printing drum having a large number of composite type faces, together with a special form of selective mechanism for linking the keyboard to the drum whereby any desired type face is selected on a digital or percentage basis. As a result of this feature, it is possible to print any one of 1000 composite indicia by using only thirty operating levers or keys corresponding to the units, tens and hundreds digits of a given code number. These thirty keys are preferably arranged in three rows of ten keys each, corresponding to the units, tens and hundreds digits of the particular numerical code number assigned to the type faces.

Another feature relates to a machine for printing directly any one of a large number, for example 1000, of composite characters under control of permuted combinations of electric signals.

A further feature relates to a composite type face printing machine wherein the individual type faces are selected for printing by a percentage-controlled selector mechanism, which can be operated either by remote control e. g., by coded combinations of telegraph impulses, or directly by means of mechanical or electro-mechanically-controlled key levers.

2

A further feature relates to a type drum or platen carrying a series of composite type faces on its periphery, together with a novel selector mechanism for positioning said drum with any desired type face in registry with a printing point.

A further feature relates to a novel form of composite type face for printing machines.

A still further feature relates to a printing drum having a series of composite type faces, each representing a coded combination of intelligence signals to be printed or reproduced.

A still further feature relates to the novel organization, arrangement and relative location and interconnection of parts which cooperate to produce a compact and efficient printer for recording composite data such as meteorological conditions, navigational conditions, and in fact any kind of composite coded data in the form of an ideograph.

Other features and advantages not specifically enumerated will be apparent after a consideration of the following detailed descriptions and the appended claims.

While the invention will be described particularly in connection with a printer which is controlled remotely by telegraph signals, it will be understood that the control and printing mechanism can be operated directly either by manually operated keys such as in the ordinary manual typewriter, or by electro-mechanically-operated keys such as in the ordinary electro-mechanical typewriter.

Furthermore, while the invention will be described in connection with the transmission of coded data such as used in international meteorological communications, it will be understood that the mechanism disclosed is capable of a wide variety of uses. Accordingly, in the drawings,

Fig. 1 is a plan view of the machine, with the top cover plate removed to show the relative location of the printing platen or drum, the recording tape and related parts.

Fig. 2 is a schematic end view of Fig. 1, with certain parts omitted for purposes of clarity.

Fig. 3 is a perspective view of the printing drum or platen.

Figs. 4 and 5 are detailed views of the selector mechanism for controlling the rotary motion of the printing drum.

Fig. 6 is a view of the selecting mechanism for controlling the longitudinal setting of the printing drum.

Fig. 7 is a composite structural and schematic circuit diagram of the electrical controls for op-

erating the selector mechanism of the printer by coded combinations of electrical impulses.

Fig. 8 is a chart showing the coded combinations of impulses used to control the mechanism of Fig. 7.

Fig. 9 is a developed lay-out view showing the arrangement and grouping of the various type faces on the drum of Fig. 3.

Fig. 10 represents one form of semi-automatic index that may be used in practicing the invention.

Fig. 11 is a chart of the various symbols incorporated in the type faces on the printing drum.

Fig. 12 is a typical page of the index of Fig. 11, showing the code numbers for punctuation marks and letters of the alphabet.

Fig. 13 is another typical page of the index showing the code numbers for certain weather conditions.

Fig. 14 represents a typical weather report.

Fig. 15 shows the code numbers transmitted for the message of Fig. 14.

Fig. 16 shows the symbols as actually printed by the mechanism of Figs. 1 to 9 under control of the code numbers of Fig. 15.

Fig. 17 is a schematic block diagram of a telegraph system embodying the invention.

Fig. 18 is a typical composite five-unit type face according to the invention.

It is common practice in marking maps, to designate weather or meteorological conditions by special indicia or code markings. Also for purposes of navigation control, the information is usually included in the following five main groups:

(1) Weather; (2) cloud condition; (3) wind direction; (4) wind velocity; (5) visibility. Thus, by various combinations of these five main characteristics, most of the information necessary for aerial or other kinds of navigation are discernible. Heretofore, two general methods of transmitting this type of information have been employed, namely by telefacsimile transmission or by transmitting the description of the conditions by ordinary telegraph methods, wherein each letter of the written description is transmitted as a code combination of telegraph impulses. The telefacsimile method while satisfactory, is limited as to the detail which can be transmitted by commercial telefacsimile systems and also by the reliability of the transmission channel, particularly where a radio channel is employed. The usual letter-by-letter telegraph message transmission method, is costly and requires a considerable "holding" time for the transmission channel. In accordance with the present invention, the five main divisions or characteristics above mentioned, are transmitted by previously assigned code numbers which can be transmitted by any known method of electrical transmission. At the receiving station, these coded impulses representing the code numbers, instead of being recorded as numbers or as letters as is done in the usual printing telegraph system, cause the reproduction directly of a single composite indicia which may represent a relatively long descriptive message. By this novel method, there is effected not only a great reduction in transmission time for a given amount of intelligence to be reproduced, but the actual reproduction is effected directly in a single composite character thus reducing the chances or error.

In accordance with one phase of the invention, the original weather or meteorological data are translated into coded numbers. These numbers are used to operate any well-known telegraph tape perforator which in turn is used to operate a corresponding tape-controlled telegraph transmitter. By employing code numbers of three digits, it is possible to transmit approximately 1000 different composite symbols. At the receiving station, the telegraph impulses representing these three digits are applied through a conventional telegraph distributing mechanism to control a printing machine of novel construction. This machine comprises, in general, a cylindrical printing drum or platen on which the 1000 symbols are arranged in coordinate rows peripherally and longitudinally of the drum. A specially designed percentage selector mechanism is controlled by the received electric impulses so as to position the drum with the proper selected composite symbol or type face adjacent a printing hammer or the like.

For example, the numbers 000 to 006 may be assigned to the seven punctuation marks; the numbers 007 to 032 may be assigned to the 26 letters of the alphabet; the numbers 033 to 042 may be assigned to the numerical digits 0 to 9; the numbers 043 to 799 may be assigned to 757 different composite type faces or symbols representing 757 different combinations of the above-mentioned five weather conditions. The remaining code numbers 800 to 999 may be assigned to represent individual indicia or symbols each representing a different individual weather condition as represented in Fig. 22.

For ease in remembering and locating the various symbols, the following is a typical arrangement under the five main headings.

A Weather	B Clouds	C Wind direction	D Wind velocity	E Visibility
1. Sunshine	1. No clouds	1. N	1. 1-7 M. P. H.	1. Normal.
2. Haze	2. ¼th cloudy	2. NE	2. 8-18 M. P. H.	2. Poor.
3. Fog	3. ½ covered	3. E	3. 19-31 M. P. H.	
4. Drizzle	4. ¾ covered	4. SE	4. 32-38 M. P. H.	
5. Rain	5. All covered	5. S	5. 39-46 M. P. H.	
6. Snow	6. Obscured	6. SW	6. 47-54 M. P. H.	
7. Hail		7. W	7. 55-75 M. P. H.	
8. Line squall		8. NW	8. 76 M. P. H.	
9. Thunderstorm				
10. Hurricane				
11. Tornado				
12. Warning symbols				

It will be found convenient to assign the code numbers, for example 043 to 799 to the various combinations of weather conditions in accordance with the following typical arrangement.

Weather condition:

Sunshine	043–170
Haze	171–298
Fog	299–362
Drizzle	363–394

Weather condition:—Continued.

Rain	395–522
Snow	523–550
Hail	551–614
Line squall	615–654
Thunderstorm	655–718
Hurricane	719–758
Tornado	759–790
Warning symbols	791–799

In the event that it is desired to reproduce individual symbols for local or inland weather report communications, they may be assigned in accordance with the following chart.

1. Weather symbols	800–812
2. Clouds symbols:	
Classification	813–826
Observation	827–834
Direction of movement of coluds	835–850
3. Fog symbols	851–858
4. Wind symbols, direction	859–874
5. Wind symbols, velocity	875–886
6. Ceiling symbols	887–896
7. Visibility symbols	897–906
8. Auxiliary symbols	907–926
9. Atmosphere pressure symbols	927–932
10. Barometer movement symbols	933–940
11. Temperature symbols	941–954
12. Humidity symbols	955–965
13. Rain gauge symbols	966–975
14. Time symbols	976–999

Referring to Fig. 17, there is shown in block diagrammatic form, a typical communication system for practicing the invention. At the transmitting point the weather reports are translated into their respective code numbers. For purposes of explanation, assume that the report to be sent is as follows:

Hazy weather—cloudy three-quarters covered—wind north—wind velocity 32 to 38 M. P. H.—visibility poor.

The composite character representing this complete information is illustrated in Fig. 18 as will be clear from the table given in Fig. 11. The code number assigned to this particular composite character may for example be 206. These code digits are set up on the keyboard of any well-known type of telegraph keyboard-controlled perforator 1, which is arranged to perforate the tape 2 with transverse rows of perforations in accordance with the permutation code shown in Fig. 8. Since each composite character is to be spaced from the succeeding character on the printed tape at the receiver, each set of three digits is followed by the letter "*n*" which controls the single space function between successive printed characters as indicated by the code in Fig. 8. If no space is to be had between successive printed composite characters on the receiving tape, the three code digits are followed by the "R" signal, while if a multi-space is to be produced at the receiver between successive composite characters, the three code digits are followed by the "M" signal. If the tape is to be fed without any printing whatever, the "S" signal is transmitted.

Accordingly, under the above assumption, the code to be transmitted is 206N. Thus, for the numeral 2, the tape will be perforated in positions 2 and 3. For the numeral 0, the tape is perforated in positions 2 and 4. For the numeral 6, it is perforated in the position 4, while for the letter "N" it is perforated in positions 1 and 4. It will be understood that the tape is automatically provided with regular feed holes along its edge so as to control its automatic feeding through the tape perforator and the tape transmitter. For a detailed description of one kind of tape perforator that may be used, reference is hereby made to U. S. Patent No. 2,308,543, the disclosure of which is expressly incorporated herein by reference.

The perforated tape is fed through any well-known type of tape-controlled telegraph transmitter 3, whereby each transverse set of code perforations is converted into a corresponding code combination of electric impulses. For a detailed description of a typical tape-controlled transmitter, reference is made to U. S. Patent No. 2,213,476, the disclosure of which is expressly incorporated herein by reference. These successive code combinations of electrical impulses are then applied to modulate or key any well-known radio transmitter 4, preferably of the continuous wave type.

At the receiving station which may be aboard an aircraft, vessel or at any other point at which the weather signals are to be recorded, the coded combinations of electric impulses are detected and amplified in the conventional radio receiver 5 to produce direct current impulses corresponding to those originally delivered by device 3 at the transmitter. These impulses are then applied to a commutator or distributing switch to control the printing machine 6 according to the invention, the printing of each complete composite character being effected in a single printing operation. In accordance with one feature of the invention, these composite characters may be referred to generically as ideographs and are preferably all of the same size and arrangement. Thus, as shown in Fig. 18, the generic symbol may consist of a square or rectangle divided into four quadrants designated A, B, C, D, and a central circular region E. The symbol for the weather condition e. g., haze, is in quadrant A; the symbol for cloudy weather is in quadrant B; the symbol for wind direction is in quadrant C; the symbol for wind velocity is in quadrant D; and the symbol for visibility is in section E. Therefore, the reception of each set of three code combinations of impulses results in the automatic and direct printing in a single printing operation of the desired one of a great number of composite symbols. It will be understood of course, that each of the 757 composite symbols is represented by a corresponding type face on the printing drum or platen of machine 6, and the desired type face is automatically presented to the printing point under control of the received code combinations of impulses representing the three digit code numbers assigned to each composite signal as above enumerated.

Referring to the drawings, the printing machine according to the invention and represented by the block 6 in Fig. 17, comprises a cylindrical platen or drum 7 (Figs. 1 to 9). Drum 7 is slidably keyed to a square or rectangular shaft 8 mounted vertically in suitable bearings, and driven by a continuously running motor 9 through the intermediary of a slip-friction clutch 10 and gear sets 11, 11*a*, 11*b*. In the absence of any received signals therefore, the drum 7 is in continuous rotation and is in its lowermost position as shown in Fig. 2. To control the vertical sliding movement of the drum on shaft 8, the drum is supported between horizontal arms 12, rigidly fastened to vertically reciprocable lead screw shaft 14. It will be understood that the members 12,

13, allow the shaft 8 to pass freely therethrough so as not to interfere with its rotation. The drum 7 is normally held in its lowermost position as shown in Fig. 2 by retractile spring 15.

For selectively raising and lowering the drum 7, the lower end of shaft 14 has a lead screw 16 which is engaged by the thrust follower 17, attached to shaft 18. Shaft 18 is mounted for rotation, but is not capable of longitudinal motion, so that when it is positively rotated by motor 9, it causes the shaft 14 to be raised. Shaft 18 is driven from motor 9 through gear sets 11b, slip-friction clutch 20, gear set 21, shiftable clutch 22, and gear sets 23, 24 and 25. Normally, the members of clutch 22 are mechanically disengaged so that under the force of spring 15, the drum is free to drop to its lowermost position. The drum 7 is arranged to be rotated in successive stages, the first stage being a group selection, and the second stage being a unit selection. For this purpose, there are two sets of shiftable stops 27 and 28, there being ten stops in each set. The stops 27 are mounted for radial movement in a fixed ring 29, and are held in their retracted position by individual springs 30 as shown in Fig. 4. Fastened to shaft 8 and in the same horizontal plane as ring 29, is a wheel 31 (Fig. 4) which carries on its outer periphery, a series of ten teeth 32 to 41. These teeth are so related to the stops 27 that the wheel 31 can be selectively stopped in any one of ten positions corresponding to the digits 0–9. Likewise, the ten shiftable stops 28 are mounted for radial sliding movement in a fixed ring 43 (Fig. 5), and fastened to shaft 8 in the same plane as ring 43 is a wheel 44 having a single tooth 45. Thus, by selectively operating one of the stops 28, wheel 44 can be stopped in any one of its ten unit positions. Preferably, the stops 28 are responsive to the first or "hundreds" digit of the code number so that they may be referred to as group selecting stops. The stops 27 may be referred to as unit stops and respond to the second or "tens" digit of the number. Thus, by successive setting of the stops 28 and 27, the drum can be stopped in any one of a hundred different circumferential positions.

Likewise, in order to control the selective stopping of the drum in its vertical movement along shaft 8, a third series of stops 50 (Figs. 2 and 6), are radially mounted in a fixed ring 51 which cooperates with a wheel 52 fastened to shaft 53. Wheel 52 has ten peripheral teeth 54 so related to stops 50 that by means of members 16 and 17, the shaft 14 and drum 8 can be selectively stopped in any one of ten vertical positions.

As shown in Fig. 3, and in developed form in Fig. 9, the printing drum carries on its peripheral face a series of composite type faces (see Fig. 18) arranged in a series of ten parallel circumferential rows with 100 type faces in each circumferential row. Pivotally mounted adjacent the drum is a printing hammer 60 (Figs. 1 and 2), whose operation is controlled by mechanism 61 responsive to the impulse control device 62, which is shown in detail in Fig. 7.

Mounted for step-by-step feed movement between the printing hammer and the printed drum is an inked ribbon 63 (Fig. 1) which is carried on the usual ribbon spools 64. The paper on which the record is printed is in the form of a tape 65 provided on the payoff reel 66 and received on the reel 67. The recording tape passes over suitable guides 68, 69, and between the ribbon 63 and the printing hammer. It will be understood that the mechanism 61 which controls the printing hammer 60 to effect printing is connected through suitable ratchet mechanism (not shown) with the usual paper feed mechanism so that on the return stroke of the hammer the paper is automatically fed the distance of one character space as is conventional in manual typewriters.

Suitably mounted on the base of the machine is an impulse receiving and distributing mechanism comprising two commutators or telegraph distributors E—1 and E—4, such as are well known in the start-stop telegraph printing machine art. Each distributor has six separate conducting segments, four of which are used as selecting impulse-distributing segments, the fifth being a stop control segment, and the sixth being a start drum segment. Each distributor also has an inner continuous contact ring and a rotatable brush which bridges the ring with the respective segments as the brush rotates. The shaft which carries the distributor brush 70 is connected through a step-by-step or Geneva gear train 70a, 70b (Figs. 2 and 7) to the shaft which carries brush 71, so that for each complete revolution of brush 70, the brush 71 is advanced to a succeeding segment of distributor E—4.

The energization of the successive four code segments of distributor E—1 is controlled by the line relay 72 (Fig. 2), whose contacts when operated apply D. C. potential to ring 73 of distributor E—1. In accordance with well-known start-stop telegraph practice, each set of code impulses, in this case 4, is preceded by a start impulse which causes the brush shaft to be clutched through a slip-friction clutch (not shown) to the motor 9 or to a special driving motor (not shown) for the distributor mechanism. At the end of each numerical impulse combination, a stop impulse is received to declutch the distributor brush from its driving shaft.

Associated with distributors E—1 and E—4, is a permutation selection control mechanism comprising four sets of permutation bars c—1, c—2, c—3, c—4 (Fig. 7), each set consisting of four bars. Each bar is provided with an individual control electromagnet M1—M4 whose operating circuit is completed partially by the segments of distributor E—1 and partially by the segments of distributor E—4. The magnets of each set have a common return conductor RC1—RC4 which is connected to the respective one of the segments of distributor E—4. The permutation bars are connected to the armatures of their respective electromagnets so that when a magnet is energized the corresponding bar is rotated around its longitudinal axis through an angle of 180°. The bars have notches on diametrically opposite sides of their periphery, which notches are arranged in permutated combinations so that by operating the bars in any particular combination under control of the associated electromagnets, only one of the overlying ten operating bars OH—OU is allowed to move by entering the aligned notches in the associated four permutation bars. It will be understood that when the selection has been complete, the bars are automatically returned through an angle of 180° to their normal positions under control of associated springs.

The ten operating bars OH associated with the permutation bars c—1, respond to the "hundreds" digit of the code number; the ten operating bars OT associated with the permutation bars c—2, respond to the "tens" digit; the ten operating

bars OU associated with the four permutation bars c—3, respond to the "units" digit; while the four function bars M, N, R, S, associated with the four "function" permutation bars c—4, are responsive respectively to the code impulses representing "multi-space" between printed characters; "single space" between printed characters; "no space" between printed characters; and "continuous steps" corresponding to the successive operation of a spacing bar on a typewriter.

Each of the "hundreds" operating bars OH is connected to its individual arm 80 (Fig. 2), so that when one of the associated operating bars is selected it pulls member 80 down. The upper end of member 80 is connected to an arm 81 which latches at its left-hand end against the lower end of lever 82. Member 81 is pivoted adjacent its left-hand end so that when member 80 is moved downwardly, it causes the lever 82 to be rotated around its pivot 83 in a counter-clockwise direction against the tension of spring 84. The latched end of member 81 is normally held in engagement with lever 82 by a suitable spring 85.

Therefore, the first set of numerical code impulses representing the "hundreds" digit results in the selective operation of one of the "hundreds" bars and the setting of one of the ten stops 27, thus stopping the drum 8 in its first rotary selective position. The brush 71 is then advanced to the next segment to prepare the circuit for the appropriate magnets associated with the permutation bars c—2. Upon receipt of the coded impulses corresponding to the "tens" digit, one of the "tens" operating bars OT is operated. Each of these "tens" bars is connected to a corresponding individual bar 86 and thence through a pivoted latch member 87 to the lever 88 pivoted at 89. The levers 88 control the respective stops 28. It will be noted that as soon as a member 86 is operated downwardly, its pin 90 engages a pivoted lever 91 whose right-hand end is located beneath the member 80. The lever 91 may be in the form of a plate or bail which is common to all the members 86 and also common to the lower end of all the members 80. In other words, as soon as the selection for the "tens" digit begins to take place, the previously selected member 80 is pushed upwardly to release the latched end of member 81 from lever 82, thus allowing the previously selected stop to return to normal position and thereby allowing the drum to continue its rotary motion until stopped by the "units" stop 28. The drum remains in this rotary position until the selection and printing of the character is completed.

Upon receipt of the impulses corresponding to the "units" digit of the code number, the brush 71 is advanced to #3 segment, thus causing the impulses to be distributed by brush 70 to the magnets associated with bars c—3, and causing the selective operation of one of the "units" operating bars OU. Each of these bars (Fig. 2) is connected to its individual arm 100, which is linked to its individual arm 101, causing the latter to be rotated clockwise around its pivot 102. Each member 101 is latched to a corresponding lever 103, pivoted at 104, and adapted to operate the corresponding stop 50. Common to all the ten members 103, is a shiftable bail 26 so that when any stop 50 is operated it immediately operates clutch 22 causing shaft 14 to rotate and raise drum 7. Depending upon which stop 50 is operated, the wheel 52 and shaft 53 are stopped at the appropriate point thereby stopping further vertical movement of the drum. If desired, any well-known retaining and centering pawl arrangement may be provided for shaft 14 to keep it centered in its selected vertical position. When the mechanism is to be cleared for the next succeeding selective operation, this pawl may be released by any suitable mechanism (not shown) to allow the drum to restore to normal. The desired type face on the drum is now positioned in registry with the printing hammer 60.

Upon receipt of the "N" impulses, the distributors E—1 and E—4 distribute the impulses to the appropriate magnets associated with bars c—4 to operate the "N" bar (Fig. 7). This bar is connected through suitable links so that it causes the printing hammer 60 to press the recording tape and inked ribbon against the particular type face which has been presented to the printing point. It will be understood that the members 87 and 101 when selectively operated as above described, are locked in their operated position by a common locking bail (not shown), so that upon the return movement of the printing hammer 60, this bail is operated by suitable links (not shown), to allow the selected stops to return to normal. Likewise, the return of the printing hammer can operate a common clearing mechanism for all the previously operated parts. If desired, the permutation magnets (Fig. 7), can be provided with a common holding circuit so that when energized they remain energized until the completion of the printing. This holding circuit can be controlled by the printing hammer so that when the printing is completed, this common holding circuit is broken and the mechanism is cleared to normal in readiness for the next operation. If desired, instead of locking the magnets, the various operating bars (Fig. 7), can be held in locked position until the printing hammer 60 has completed its printing movement, whereupon the locking members for the said bars can be released. When the previously selected members 103 have been restored to normal, the clutch 22 is disengaged and the retaining and centering pawl for the shaft 14 is likewise disengaged thus allowing the drum to return downwardly to normal.

Referring to Fig. 1, it will be noted that the recording tape after it passes the printing point, passes a reflecting mirror 120 adjacent to which is a lens arrangement 121 for projecting an image of the printed character on the ground glass screen 122 in the front wall 123 of the machine casing.

While in the foregoing, the printer machine is controlled by permuted electric impulses, it will be understood that the machine can be operated directly by manual keys. Thus, each of the ten members 81, can be linked to corresponding keys 110 on the keyboard (Fig. 2); the ten members 87 may likewise be linked to ten keys 111; the ten members 101 may be linked to keys 112; and the bars M, N, R, S, (Fig. 2), may likewise be linked to corresponding keys. This linkage mechanism and key arrangement can be the same as is used in ordinary manual keyboard typewriters, and if desired the keys may be provided with a locking mechanism so that each key remains in its operated position until released by the operation of a subsequent key. Merely for simplicity in the drawings, only one of each of these keys is shown, but it will be clear that they can be arranged in three numbered rows of ten keys each, and a fourth row will include the keys M, N, R, S. It will also be understood that the keys 110, 111, 112, M, N, R, S, instead of being operated directly by hand, can each have an individual operating

electromagnet which can be energized by signalling current received from a distance.

In order to facilitate the ascertainment of the code number assigned to the various type faces, an automatic index such as shown in Fig. 10, may be employed. This index may be of the construction disclosed in U. S. Patent No. 2,141,761 having a movable pointer 115 for selecting the particular pages or groups of pages desired; and a spring retained cover 116 which can be released by a button 117. As shown in Fig. 10, the front cover of the automatic index will have a table of contents numbered in accordance with the various general classifications, so that by moving pointer 115 to the appropriate point and pressing the button 117, the desired page showing the composite type faces and their corresponding code numbers can quickly be found.

It will be understood that various changes and modifications may be made in the particular embodiments disclosed without departing from the spirit and scope of the invention. Features disclosed herein but not claimed, are claimed in co-pending applications Serial No. 542,492, filed June 28, 1944, and Serial No. 513,820, filed December 11, 1943.

What I claim is:

1. In a machine of the character described, a type face drum having a large number of type faces on the periphery thereof each type face comprising a plurality of separate intelligence bearing elements, said drum being mounted for rotary and axial movement; first, second and third digit selector means each including permutation-control mechanism; and means responsive to the settings of said permutation control mechanisms to position the drum with a selected type face in registry with a printing point.

2. In a machine of the character described, a drum carrying a series of type faces each having an identifying code number each type face comprising a plurality of separate intelligence bearing elements; first, second and third digit selector means including permutation control mechanisms adapted to be set in permuted combinations in accordance with the identifying code numbers; means to support said drum for rotary and axial movements, means responsive to the combined settings of the first and second digit selector means to control the rotary setting of said drum, and means responsive to the setting of the third digit selector means to control the axial setting of the drum.

3. In a machine of the character described, a type face carrier mounted for coordinate movements each type face comprising a plurality of separate intelligence bearing elements, a first digit selector means including a series of shiftable stops, a second digit selector means including a series of shiftable stops, the product of the number of stops in the two series equaling the number of positions at which the drum is to be stopped in one of its coordinate movements, means responsive to the setting of said stops for controlling said coordinate movement, other digit selecting means including another set of shiftable stops, means responsive to the setting of said other selecting means for controlling the other coordinate movement of the drum, and permutation control means arranged to be set in permuted combinations under control of code combinations of impulses for controlling said digit-selecting means.

4. In a machine of the character described, a rotatable and axially movable type face drum with the type faces arranged in coordinate rows each type face comprising a plurality of separate intelligence bearing elements, two sets of shiftable stops, the product of the number of stops in the two sets equaling the number of type faces in each coordinate row, another set of shiftable stops, permutation controls for each set of stops, and means for setting said permutation controls in accordance with preassigned digital code numbers for the respective type faces.

5. In a machine of the character described, a drum having a series of type faces each having a preassigned identifying code number, a printing hammer for cooperation with said type faces, means to rotate said drum, means to produce relative linear movement between said drum and hammer, a plurality of cam wheels rotatable with the drum, one cam wheel being a group stopping control and the other being a unit stopping control, a series of shiftable stops mounted for movement toward and away from the first cam wheel, a second series of shiftable stops mounted for movement toward and away from the second cam wheel, permutation controls for selectively moving the first set of stops, and other permutation controls for selectively moving the second series of stops.

6. In a machine of the character described, a drum having a series of type faces each represented by a preassigned multiple-digit code number, a printing hammer mounted for cooperation with said type faces, means to rotate said drum, means to produce relative linear movement between said drum and hammer, a plurality of cam wheels rotatable with the drum, a first series of shiftable stops cooperating with said cam wheels, means to set a selected one of said stops under control of one digit of the code number of a desired type face, a second series of shiftable stops cooperating with the said cam wheels, means to set said second series of stops under control of another digit of said code number, and means responsive to the combined setting of a stop in each of said series for stopping the drum with a selected type face in line with the printing hammer.

7. In a machine of the character described, a drum having a series of type faces each represented by a corresponding plural-digit code number, a movable printing hammer for pressing a recording web against the selected type face, means to rotate the drum, a pair of cams fastened to the drum shaft, a plurality of selectably shiftable stops for cooperation with one of said cams, another plurality of shiftable stops for cooperation with the other cam, permutation control members arranged to be set in accordance with one digit of the code number assigned to each type face, other permutation control members arranged to be set in accordance with another digit of said code number, means responsive to the setting of the first permutation members for moving a selected stop in the first set into engagement with the associated cam, and means responsive to the setting of the second permutation members for moving a selected stop in the second set into contact with the associated cam.

8. A machine according to claim 7 in which the drum is normally rotating and said stop members are arranged to stop the drum in successive group and unit positions, and means are provided for automatically releasing the selective stop member of the first set in response to the selection of a stop member of the second set.

9. A machine according to claim 7 in which

means are provided for moving the drum axially, and a third cam is provided together with a corresponding third series of shiftable stops, and means for selectively setting one of said stops in the third series in accordance with a third digit of said code number to control the selective stopping of the drum in its axial movement.

10. In a machine of the character described a printing drum, first driving means for rotating the drum, second driving means for moving the drum axially, a source of motive power for both of said means, a slip-friction clutch between said source and the first-mentioned means, a slip-friction clutch between said source and the second-mentioned means, a shiftable clutch between said source and said second-mentioned means, permutation controlled stops adapted to be set in accordance with two digits of a code number representing a type face on the drum for selectively stopping the first-mentioned means, and other stopping means adapted to be set in accordance with a third digit of said code number for selectively stopping the second-mentioned means, and means responsive to the setting of said other stopping means for operating said clutch to couple the second driving means to said drum.

11. In a machine of the character described a printing drum, a plurality of numerical keys arranged in groups and adapted to be operated in accordance with pre-assigned plural-digit code numbers for each type face on the drum, each type face comprising a plurality of separate intelligence bearing elements, means to rotate the drum to bring a desired row of type faces to a printing position, group and unit selective stopping members for stopping the drum in a desired position, means connecting each of the keys in one group with one set of stopping means to operate a group stopping member, means connecting each of the keys in another group with another set of stopping means to operate a "units" stopping member, the number of selected positions in which said drum can be stopped being the product of the number of keys in said groups, and permutation control means arranged to be set in permuted combinations in accordance with said code numbers for selectively controlling said stop members.

12. In a printing machine of the kind which is controlled by coded combinations of electrical impulses, a type face drum having a series of type faces each represented by a corresponding plural-digit code number each type face comprising a plurality of separate intelligence bearing elements, means to subject said drum to continuous rotation, sets of selective stopping means for said drum one set acting to stop the drum in a group position, another set acting to stop the drum in a units position, impulse distributing means comprising a group impulse distributor and a units impulse distributor operated in fixed time relation, permutation control mechanism set under control of said distributors, and means between said permutation mechanisms and said sets of stops for selectively operating the latter.

13. In a printing machine of the type which is controlled by coded combinations of electric impulses, a printing drum and a printing hammer, means to position said drum with a desired type face in registry with said hammer, each type face comprising a plurality of separate intelligence bearing elements, the last-mentioned means including a pair of commutators one of which is rotated at a multiple speed with respect to the other, a plurality of sets of permutation members, electric control circuits for controlling said members, said circuits being completed in part by the first commutator and in part by the second commutator, the second commutator serving to transfer the control circuit from one to the other of said sets of permutation members in cyclical succession, a plurality of selectively shiftable stops for controlling the stopping of said drum, and means for operating said stops in accordance with the setting of said permutation members.

14. A machine according to claim 13 in which means are provided for maintaining the drum in rotation when none of said stops is selectively set.

15. In a machine of the character described, a printing drum mounted for rotation and for axial movement, a plurality of cam wheels affixed to the drum shaft for rotation therewith, a stationary ring surrounding each cam wheel, a plurality of radially shiftable stop members mounted in each ring, control means for moving a selected one of the stops in the first ring into stopping relation with the associated cam wheel to stop the drum in a "group" position, other control means for moving a selected stop in the second ring into stopping relation with the associated cam wheel to stop the drum in a "units" position, a third cam wheel driven from the drum shaft, a third stationary ring surrounding said third wheel and having a series of radially shiftable stops, means to move the drum axially, and control means for moving a selected stop in said third set into stopping relation with said third cam wheel whereby the axial movement of said drum is stopped to present a selected type face to a printing point, said drum being held in its previously stopped unit position while it is being moved axially.

16. A machine according to claim 15 in which the selected stop in the first set is automatically released in response to a setting of a stop in the second set.

17. A machine according to claim 15 in which each of said sets of stops is provided with permutation members and coded electric impulse distributors for setting said permutation members and thereby selecting a desired stop in each of said sets.

18. A machine according to claim 15 in which each of said sets of stops has an associated group of permutation control members which are connected successively in circuit under control of "group" and "units" impulse distributors.

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