

998,833.

H. W. BODWELL.
CODE CHANGING SYSTEM.
APPLICATION FILED MAR. 15, 1911.

Patented July 25, 1911.

3 SHEETS-SHEET 1.

FIG. 1

CHECK Nos.	CHECKS	CHECK Nos.	CHECKS	CHECK Nos.	CHECKS
00	00 00 00 00 00	34	00 00 00 00 00	68	00 00 00 00 00
01	00 00 00 00 00	35	00 00 00 00 00	69	00 00 00 00 00
02	00 00 00 00 00	36	00 00 00 00 00	70	00 00 00 00 00
03	00 00 00 00 00	37	00 00 00 00 00	71	00 00 00 00 00
04	00 00 00 00 00	38	00 00 00 00 00	72	00 00 00 00 00
05	00 00 00 00 00	39	00 00 00 00 00	73	00 00 00 00 00
06	00 00 00 00 00	40	00 00 00 00 00	74	00 00 00 00 00
07	00 00 00 00 00	41	00 00 00 00 00	75	00 00 00 00 00
08	00 00 00 00 00	42	00 00 00 00 00	76	00 00 00 00 00
09	00 00 00 00 00	43	00 00 00 00 00	77	00 00 00 00 00
10	00 00 00 00 00	44	00 00 00 00 00	78	00 00 00 00 00
11	00 00 00 00 00	45	00 00 00 00 00	79	00 00 00 00 00
12	00 00 00 00 00	46	00 00 00 00 00	80	00 00 00 00 00
13	00 00 00 00 00	47	00 00 00 00 00	81	00 00 00 00 00
14	00 00 00 00 00	48	00 00 00 00 00	82	00 00 00 00 00
15	00 00 00 00 00	49	00 00 00 00 00	83	00 00 00 00 00
16	00 00 00 00 00	50	00 00 00 00 00	84	00 00 00 00 00
17	00 00 00 00 00	51	00 00 00 00 00	85	00 00 00 00 00
18	00 00 00 00 00	52	00 00 00 00 00	86	00 00 00 00 00
19	00 00 00 00 00	53	00 00 00 00 00	87	00 00 00 00 00
20	00 00 00 00 00	54	00 00 00 00 00	88	00 00 00 00 00
21	00 00 00 00 00	55	00 00 00 00 00	89	00 00 00 00 00
22	00 00 00 00 00	56	00 00 00 00 00	90	00 00 00 00 00
23	00 00 00 00 00	57	00 00 00 00 00	91	00 00 00 00 00
24	00 00 00 00 00	58	00 00 00 00 00	92	00 00 00 00 00
25	00 00 00 00 00	59	00 00 00 00 00	93	00 00 00 00 00
26	00 00 00 00 00	60	00 00 00 00 00	94	00 00 00 00 00
27	00 00 00 00 00	61	00 00 00 00 00	95	00 00 00 00 00
28	00 00 00 00 00	62	00 00 00 00 00	96	00 00 00 00 00
29	00 00 00 00 00	63	00 00 00 00 00	97	00 00 00 00 00
30	00 00 00 00 00	64	00 00 00 00 00	98	00 00 00 00 00
31	00 00 00 00 00	65	00 00 00 00 00	99	00 00 00 00 00
32	00 00 00 00 00	66	00 00 00 00 00		
33	00 00 00 00 00	67	00 00 00 00 00		

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3 SHEETS—SHEET 2.

FIG. 2

WORD COMPILING TABLE

00	BA	20	BE	40	BI	60	BO	80	BU
01	CA	21	CE	41	CI	61	CO	81	CU
02	AB	22	EB	42	IB	62	OB	82	UB
03	AC	23	EC	43	IC	63	OC	83	UC
04	DA	24	DE	44	DI	64	DO	84	DU
05	FA	25	FE	45	FI	65	FO	85	FU
06	AD	26	ED	46	ID	66	OD	86	UD
07	AF	27	EF	47	IF	67	OF	87	UF
08	GA	28	GE	48	GI	68	GO	88	GU
09	HA	29	HE	49	HI	69	HO	89	HU
10	AH	30	EH	50	YT	70	OH	90	UH
11	AG	31	EG	51	IG	71	OG	91	UG
12	JA	32	JE	52	JJ	72	JO	92	JU
13	KA	33	KE	53	KI	73	KO	93	KU
14	AJ	34	EJ	54	IJ	74	OJ	94	UJ
15	AK	35	EK	55	IK	75	OK	95	UK
16	LA	36	LE	56	LI	76	LO	96	LU
17	MA	37	ME	57	MI	77	MO	97	MU
18	AL	38	EL	58	IL	78	OL	98	UL
19	AM	39	EM	59	IM	79	OM	99	UM
	NA		NE		NI		NO		NU
	PA		PE		PI		PO		PV
	AN		EN		IN		ON		UN
	AP		EP		IP		OP		UP
	RA		RE		RI		RO		RU
	SA		SE		SI		SO		SU
	AR		ES		IS		OS		UR
	AS		TE		TI		TO		US
	TA		VE		VI		VO		TU
	VA		ET		IT		OT		VU
	AT		EV		IV		OV		UV
	AV		DY		GY		LY		RY
	BY		WE		WI		WO		WU
	WA		EW		IW		OW		UW
	AW		EX		IX		OX		UX
	AX		YE		YI		YO		YU
	YA		ZE		ZI		ZO		ZU
	ZA		EY		YL		OY		YD
	AY		EZ		IZ		OZ		UZ
	AZ								

WITNESSES

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3 SHEETS—SHEET 3.

FIG. 3

TRANSLATING TABLE

AB <u>01</u>	BY <u>16</u>	ES <u>33</u>	ID <u>43</u>	KU <u>86</u>	OL <u>69</u>	SI <u>52</u>	UX <u>97</u>
AC <u>01</u>	CA <u>00</u>	ET <u>35</u>	IF <u>43</u>	LA <u>08</u>	OM <u>69</u>	SO <u>72</u>	UZ <u>99</u>
AD <u>03</u>	CE <u>20</u>	EV <u>35</u>	IG <u>45</u>	LE <u>28</u>	ON <u>71</u>	SU <u>92</u>	VA <u>14</u>
AF <u>03</u>	CI <u>40</u>	EW <u>37</u>	IJ <u>47</u>	LI <u>48</u>	OP <u>71</u>	TA <u>14</u>	VE <u>34</u>
AG <u>05</u>	CO <u>60</u>	EX <u>37</u>	IK <u>47</u>	LO <u>68</u>	OR <u>73</u>	TE <u>34</u>	VI <u>54</u>
AH <u>05</u>	CU <u>80</u>	EY <u>39</u>	IL <u>49</u>	LU <u>88</u>	OS <u>73</u>	TI <u>54</u>	VO <u>74</u>
AJ <u>07</u>	DA <u>02</u>	EZ <u>39</u>	IM <u>49</u>	LY <u>76</u>	OT <u>75</u>	TO <u>74</u>	VU <u>94</u>
AK <u>07</u>	DE <u>22</u>	FA <u>02</u>	IN <u>51</u>	MA <u>08</u>	OV <u>75</u>	TU <u>94</u>	WA <u>16</u>
AL <u>09</u>	DI <u>42</u>	FE <u>22</u>	IP <u>51</u>	ME <u>28</u>	OW <u>77</u>	UB <u>81</u>	WE <u>36</u>
AM <u>09</u>	DO <u>62</u>	FI <u>42</u>	IR <u>53</u>	MI <u>48</u>	OX <u>77</u>	UC <u>81</u>	WI <u>56</u>
AN <u>11</u>	DU <u>82</u>	FO <u>62</u>	IS <u>53</u>	MO <u>68</u>	OY <u>79</u>	UD <u>83</u>	WO <u>76</u>
AP <u>11</u>	DY <u>36</u>	FU <u>82</u>	IT <u>55</u>	MU <u>88</u>	OZ <u>79</u>	UF <u>83</u>	WU <u>96</u>
AR <u>13</u>	EB <u>21</u>	GA <u>04</u>	IV <u>55</u>	NA <u>10</u>	PA <u>10</u>	UG <u>85</u>	YA <u>18</u>
AS <u>13</u>	EC <u>21</u>	GE <u>24</u>	IW <u>57</u>	NE <u>30</u>	PE <u>30</u>	UH <u>85</u>	YD <u>99</u>
AT <u>15</u>	ED <u>23</u>	GI <u>44</u>	IX <u>57</u>	NI <u>50</u>	PI <u>50</u>	UJ <u>87</u>	YE <u>38</u>
AV <u>15</u>	EF <u>23</u>	GO <u>64</u>	IZ <u>59</u>	NO <u>70</u>	PO <u>70</u>	UK <u>87</u>	YI <u>58</u>
AW <u>17</u>	EG <u>25</u>	GU <u>84</u>	JA <u>06</u>	NU <u>90</u>	PU <u>90</u>	UL <u>89</u>	YL <u>59</u>
AX <u>17</u>	EH <u>25</u>	GY <u>56</u>	JE <u>26</u>	OB <u>61</u>	RA <u>12</u>	UM <u>89</u>	YO <u>78</u>
AY <u>19</u>	EJ <u>27</u>	HA <u>04</u>	JI <u>46</u>	OC <u>61</u>	RE <u>32</u>	UN <u>91</u>	YT <u>45</u>
AZ <u>19</u>	EK <u>27</u>	HE <u>24</u>	JO <u>66</u>	OD <u>63</u>	RI <u>52</u>	UP <u>91</u>	YU <u>98</u>
BA <u>00</u>	EL <u>29</u>	HI <u>44</u>	JU <u>86</u>	OF <u>63</u>	RO <u>72</u>	UR <u>93</u>	ZA <u>18</u>
BE <u>20</u>	EM <u>29</u>	HO <u>64</u>	KA <u>06</u>	OG <u>65</u>	RU <u>92</u>	US <u>93</u>	ZE <u>38</u>
BI <u>40</u>	EN <u>31</u>	HU <u>84</u>	KE <u>26</u>	OH <u>65</u>	RY <u>96</u>	UT <u>95</u>	ZI <u>58</u>
BO <u>60</u>	EP <u>31</u>	IB <u>41</u>	KI <u>46</u>	OJ <u>67</u>	SA <u>12</u>	UV <u>95</u>	ZO <u>78</u>
BU <u>80</u>	ER <u>33</u>	IC <u>41</u>	KO <u>66</u>	OK <u>67</u>	SE <u>32</u>	UW <u>97</u>	ZU <u>98</u>

WITNESSES

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CODE-CHANGING SYSTEM.

998,833.

Specification of Letters Patent. Patented July 25, 1911.

Application filed March 15, 1911. Serial No. 614,546.

To all whom it may concern:

Be it known that I, HARRY W. BODWELL, a citizen of the United States, residing at Burlingame, in the county of San Mateo and State of California, have invented new and useful Improvements in Code-Changing Systems, of which the following is a specification.

The object of the present invention is to provide a code to be used in combination with any telegraphic code or cipher, such as the A. B. C. code, the A. I. code, Lieber's code, or any code wherein the various phrases or sentences used are represented each by a number of not more than five figures, whereby two phrases or sentences, taken from any one of said codes, may be transmitted in a single word, thereby effecting a saving of one-half of the expense of cabling the text of the message.

A further object is to provide such a code whereby the above result may be effected and at the same time each single word, thus compiled from said figures, will serve in itself as a check or proof as to the correct transmission of the word.

In the accompanying drawings, Figures 1, 2, 3 are plan views respectively of three different tables forming my improved code.

Referring to the drawings, 1 indicates a check table, having thereon a series of symbols 2, which I term checks, each symbol being designated by an ordinal number, shown at 3. These checks consist each of a horizontal line 4 and five pairs of dots 5. The positions of said several pairs, with reference to the line, whether above or below it, constitute by their different combinations the differences in the checks.

7 indicates a word compiling table (Fig. 2) comprising a series of one hundred groups 8 of letters, each group being designated by a number, as shown at 9, and each group consisting of four letters two above a line and two below it.

10 indicates a translating table (Fig. 3) which consists of a series of pairs of letters, as shown at 11, each pair comprising a consonant and a vowel. In some of the pairs the vowels are before the consonants and in others the order is reversed. The letter Y is sometimes used as a consonant and sometimes as a vowel. Opposite each pair of letters is placed the corresponding number section 12, and, beneath it, the corresponding check section 13, consisting of two dots

either above or below a short horizontal line.

The nature of the code will be understood by means of specific examples and explanations, which are as follows:—

Example: Compiling a message of two words which embody four phrases taken from the A. B. C. code 5th edition:

00493	We cannot accept the order.....	00	65
31038	Price has advanced since writing you.....	49	
		33	
00 49 33 10 38	(check number 30).....	10	
		38	
BAIMESNAYE	Total	130	
30937	Lowest price possible is.....	30	
88256	\$6.10 per case	93	70
		78	
30 93 78 82 56	(check number 39).....	82	
		56	
NEUSYOFUWI	Total	339	

The message reads "BAIMESNAYE NEUSYOFUWI."

Explanation: In the A. B. C. code 5th edition, the sentence "We cannot accept the order" is represented by the number 00493, and the sentence "Price has advanced since writing you" is represented by the number 31038. By joining these two numbers together there is produced a number of ten numerals as shown in the above example (0049331038). This number is converted into a word of ten letters by the combined use of the check table and the word compiling table, and the manner of doing so is as follows: At one side jot down each two numerals that form the number so as to form a column of five numbers, as shown in the example. Add up the column and the total gives what we will call the check number. When the total exceeds 99, ignore the hundreds and employ the last two numerals as the check number; for instance, were the total 100 the check number would be 00; were the total 199, the check number would be 99; were the total 411, the check number would be 11, and so on. In the above example the total being 130, the check number is 30. Refer to the check table, wherein are found check numbers ranging from 00 to 99 inclusive, and to the right of each check number appears the check that applies to the same. The check that applies to check number 30 is found to be as follows:—

Copy this check directly beneath the number, so that each two dots occupy a position directly below two numerals, as shown in the example. For convenience in referring to these dots we will speak of them as being

“related” to the numerals below which they appear. The number is now ready to be converted into a word of ten letters by means of the word compiling table, the conversion being made two letters at a time. Refer to the word compiling table, wherein are found numbers ranging from 00 to 99 inclusive, and opposite each number are found two sets of letters (consisting of two letters each) separated by a line, one set being above the line and the other set below the line, both applying to the same number. Each two dots in the check copied beneath the number indicate which set of letters is to be used in substituting letters for the two numerals to which each two dots are related. Dots above the line in the check indicate that letters above the line must be used to represent the numerals to which such dots are related, while dots below the line in the check indicate that letters below the line must be used to represent the numerals to which they are related. Hence, in keeping with the requirements of the check copied beneath the number 0049331038, the numerals 00 must be converted into the letters BA (taken from above the line), 49 must be converted into the letters IM (taken from below the line), 33 into the letters ES (taken from below the line), 10 into the letters NA (taken from above the line), and 38 into the letters YE (taken from above the line). These five sets of letters joined together form the word BAIMESNAYE.

In the A. B. C. code, 5th edition, the phrase “The lowest price possible is” is represented by the number 30937, and the phrase “\$6.10 per case” is represented by the number 88256. The manner of embodying these two phrases into one word is the same as explained above. Joining together the two numbers that represent the phrases produces the number 3093788256, and making the addition in the manner already explained gives a check number of 39 as shown in the example. Reference to the check table shows the check that applies to the check number 39 to be as follows:—

Copy this check directly beneath the number as shown in the example. Adhering to the rule that dots above the line of the check call for letters above the line in the word compiling table, and dots below the line call for letters below the line, the conversion of the number into a word is as follows: 30 is converted into NE (taken from above the line), 93 is converted into US (taken from below the line), 78 into YO (taken from above the line), 82 into FU (taken from below the line), and 56 into WI (taken from below the line). These five sets of letters joined together form the word NEUSYOFUWI.

The compiling of the message is of course done on a blank sheet of paper, and when completed, the words that have been formed are copied on the regular blank form furnished by the cable companies.

The message above compiled reads BAIMESNAYE NEUSYOFUWI. These two words when translated give the four phrases that were taken from the A. B. C. code, which, were it not for the assistance of my improved code, would require the employment of four A. B. C. code words.

Example: Translating the message BA-IMESNAYE NEUSYOFUWI:

BAIMESNAYE.....	00	80
	49	
00 49 33 10 38 (check number 30)	33	
	10	
	38	
	130	
Total		
00493 We cannot accept the order.		
31038 Price has advanced since writing you.		85
NEUSYOFUWI.....	30	
	93	
30 93 78 82 56 (check number 39)	78	
	82	
	56	
	339	
Total.....		
30937 Lowest price possible is.		90
88256 \$6.10 per case.		

Explanation: In translating a word, the first thing to be done is to convert the word into a number of ten numerals, the conversion being accomplished two numerals at a time. This is done by means of the translating table, in which all sets of letters employed in the code appear, alphabetically arranged, and opposite each set of letters are found the two numerals that the letters represent and also the section of check that is related to the numerals. (Each section of check is one fifth of a complete check). In the above message BAIMESNAYE is the first to be translated, so write the word on a blank sheet of paper, dividing the word into syllables of two letters each, refer to the translating table, and look for the first two letters of the word, BA, which are found to represent the two numerals 00. Write these two numerals directly beneath the letters BA, and below the numerals copy the section of check related to same, which as shown in the translating table is . . . The next two letters, IM, are found to represent 49, so write 49 below IM and below these two numerals copy the section of check related to same, it being — In copying these sections of checks join the second section to the first section by elongating the line of the first, and continue in the same manner with the third, fourth, and fifth sections, so that when the conversion of a word into a number has been completed, the check formed below the number will have an unbroken line. Continuing with the translation, the third set of letters, ES, is found to represent 33, so write 33 beneath ES and copy the section of check related to this number, it being — The next letters,

NA, represent 10, so write this number beneath NA and copy the section of the check as above described. The next letters YE, represent 38, so write this number below YE and copy the section of check. As a result of this operation the word BAIMESNAYE has been converted into the number 0049331038, and at the same time a check has been formed below the number as shown in the example. The object of this check is to prove whether or not the word has been transmitted without error. At one side jot down each two numerals that form the number, in the same manner as when compiling a word, add up the column, and it gives a check number of 30. Refer to the check table and compare the check that has been formed below the number with the check that applies to the check number 30 in the check table. If the two checks do not exactly coincide it is a proof that some error has occurred in the transmission of the word. In the above example having compared the two checks and finding that they coincide, we proceed with the translation of the word. Divide the number 0049331038 into two numbers of five numerals each, 00493 and 31038, look up these numbers in the A. B. C. code, and opposite each write the phrase that corresponds to same, and the translation of the word BAIMESNAYE is completed.

The translation of the word NEUSYOFUWI is accomplished in identically the same manner as the word above described, so an explanation of the translation of this word is unnecessary.

The above examples show how four phrases taken from the A. B. C. code 5th edition are embodied in two words by the use of my improved code, thus effecting an economy of 50% in the expense of cabling the text of the message. The manner of employing the code is identically the same whether two phrases are to be cabled or a thousand phrases. The manner of employing the code is the same whether used in combination with the A. B. C. code, A. 1 code, Lieber's code, or any other code wherein the phrases or expressions are represented by numbers of five numerals. The same general plan of employing the code is followed when used in combination with any code wherein the phrases or expressions are represented by numbers of less than five numerals.

From the foregoing examples and explanations it will be seen that by my improved code two useful results are obtained. By the substitution of letters for the code numbers a single word of ten letters can be used to cable two phrases or sentences of the code. Because the word is composed of five syllables, each consisting of a vowel and a consonant it will always be a pronounceable

word, and therefore no objection will be made by the cable company to its transmission by cable. There are obviously 100 numbers of two digits which can be formed of the digits 0 to 9 inclusive. Therefore 100 permutations of letters, two at a time, each consisting of one vowel and one consonant, would provide sufficient symbols for said numbers, and enable all variations of two code numbers, of five digits each, each to be represented by a single word of ten letters and of five syllables, each syllable containing a vowel and a consonant. But to obtain the second result, namely, to insure that the message has been correctly transmitted, I employ, not 100 syllables of two letters, each consisting of a vowel and a consonant, but 200 such syllables. I find that by using the letter Y sometimes as a vowel and sometimes as a consonant 200 different syllables of this kind can be formed. I am thus enabled to substitute for each number of two digits, from 00 to 99 inclusive, either one of two such syllables. A choice being thus provided, I am thus able to employ the election as a means of verifying whether the translation has been correctly made. For I can take some function of the original code numbers and use this function as a means of determining which of the two syllables I select in each case. This function may be obtained in a variety of ways, but I prefer the method shown as being simple and not liable to error. By this means there is obtained a check number, which, upon referring to the table, gives a check showing in which one of 24 different ways the five groups, of two digits each, are to be translated into syllables, that is, in which one of two ways each group in turn is to be so translated. The numerals having been translated into letters, the message is ready for transmission. If, upon re-translating the word into code numbers, the check obtained from the re-translation does not correspond with the check number of the code numbers produced, it is known that an error has been made in transmission.

Since my invention may possibly be varied by using instead of groups each of two letters, groups of another number of letters as one or three or more, I desire it to be understood that in the claims the word "group" is to be so interpreted.

It will be seen that, of the above tables, the word compiling table is the most important. The translating table could, except for convenience, be dispensed with, and an inferior form of the invention could also be used by even dispensing with the check table. In the word compiling table the essential characteristics are that, for each of the series of numbers, there shall be a pair of groups of two letters, and that these groups shall be distinguishable from one another inde-

pendently of the form of the letters themselves. In the present instance this distinction is obtained by placing one group above a line and the other group below it. But
 5 evidently the same result could be obtained in other ways, as, for instance, by marking one of the groups with a star and the other without a star. The inferior form of the invention might be obtained by dispensing
 10 with the check numbers, and providing a rule, dependent upon all the figures of a code number for distinguishing between the groups of said pairs. Such a rule might be that if the sum of all the digits in the
 15 complete code number were odd, the upper group of letters should be taken for the translation of said first pair of digits, if even, the lower group; for the second pair of digits, the same rule could be used except
 20 that the sum would be obtained of the figures taken two at a time; for the third group, three at a time; and so on. From this it appears that the check table is not absolutely indispensable in my invention, and that the
 25 only indispensable table is that shown in Fig. 2. However I prefer the form of the invention illustrated, as thereby no error can be made in transmission without its being detected.

30 I claim:—

1. In a code-changing system, a series of code numbers, and a corresponding series of pairs of groups of code-changing letters, the two groups of each pair being distinguish-
 35 able from each other independently of the letters themselves of the groups, substantially as described.

2. In a code-changing system, a series of numbers, and a corresponding series of pairs
 40 of groups each of two letters, the two groups of each pair being distinguishable from each other independently of the letters themselves of the groups, substantially as described.

3. A code-changing system comprising a series of numbers, a series of pairs of groups
 45 of two letters each consisting of a vowel and a consonant, said groups being distinguishable from one another by means other than the letters themselves forming the groups, a series of compound checks, each consisting
 50 of check sections, each check section being indicative of which group of a corresponding pair is to be employed for translation of the number, substantially as described.

4. A code-changing system for changing
 55 code numbers comprising a series of numbers, a series of pairs of groups of two letters each consisting of a vowel and a consonant, said groups being distinguishable from one another by means other than the
 60 letters themselves forming the groups, a series of compound checks, each consisting of check sections, as many in number as there are numbers of the series in the total code number to be translated, each check
 65 section being indicative of which group of a corresponding pair is to be employed for translation of the number, substantially as described.

5. In a code-changing system, a series of
 70 numbers of two digits, and a corresponding series of pairs of groups of letters, the two groups of each pair being distinguishable from each other independently of the letters themselves of the groups, and a correspond-
 75 ing series of symbols adapted to indicate which group of the pair is to be employed, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing
 80 witnesses.

HARRY W. BODWELL.

Witnesses:

FRANCIS M. WRIGHT,
 D. B. RICHARDS.