again made in February 1955. The developed data are shown in Fig. 3. The measured values are parallel to and slightly below the calculated values up to about 95 kc. Above this frequency the measured attenuation increased rapidly, peaked at 127 kc, and then decreased to approximately the calculated curve at 138 kc. Since the line was transposed to a 3-kc pattern, the attenuation peak between 95 and 138 kc was probably caused by inadequate transpositions which permitted energy to be absorbed in other wires of the line.

Factors contributing to the measured attenuation being lower than computed values at frequencies below 95 kc were the line pin spacing and the test temperature. Computations were for a pin spacing of 8 in. and a temperature of 68 deg. F., whereas the actual pin spacing was 12 in. and the temperature at the time of the test was about 40 deg. F. Any effect of the neoprene covering was not apparent.

Conclusions

All of the work thus far accomplished indicates that ACSR is technically suitable for railroad signal and communications circuits and gives good promise of advantages in economy and in service continuity. Because the communications characteristics of different types of conductors vary at different rates with changes in frequency, ACSR cannot be compared with copper types of conductors on an equal-conductivity basis as is commonly done for d.c. or low-frequency power circuits. A particular size of ACSR, however, may combine to a considerable degree the communications characteristics of a solid copper conductor with the high mechanical strength of a copper-covered steel conductor. Experience with the use of ACSR will no doubt result in expansion and refinement of data relating to its communications characteristics and to installation practices.

Train Operations When CTC Fails

If the CTC code line fails, how do you operate trains, i.e., authorize train movements until centralized traffic control is restored? If the communications circuits are also out of service, how do you operate trains until communications or CTC is restored? Please explain in detail.

Emergency Local Control

By H. B. Garrett

Signal Engineer
Southern Pacific
San Francisco, Cal.

Southern Pacific provides an emergency control panel at each station which has the necessary signal and switch control levers for the functions at that point. In addition, the emergency control panel has a transfer lever which transfers the control from the dispatcher code line to the emergency levers. Normally this transfer lever is sealed and cannot be operated without breaking the seal.

In the event of failure of code line and assuming telephone communication is still available, either of two methods can be used.

(1) Have employees available at each station to set up traffic direction and operate power switches as instructed by the dispatcher. If stations are relatively close together, one man with motor car can possibly handle two or more stations. This method of operation is contingent upon the communication line being intact since it would be necessary for the dispatcher to instruct the men in the field on what line-up to make.

(2) With neither code line or communication facilities available, the movement of trains becomes more difficult. Usually auxiliary communication of some sort, such as a commercial telephone system, can be provided at each end of the affected territory and with such a communication system, arrangements made to fleet the trains through the territory. A signalman or other qualified man could be assigned to the first train of the fleet and another man in the last train. The first man would get off at each station and make the line up with the last man getting off and reversing the line-up for movements in the opposite direction. After the first fleet clears the territory or a given section, the fleet moving in the opposite direction is started. Similarly, one qualified man would ride the first train and another the last train. In this instance, however, the first train would move through without delay since the traffic direction had previously been set up but it would still be necessary for the man riding the last train to stop at each station and reverse traffic selection for the opposite direction.

Either of the above methods of operation are cumbersome and the second method particularly results in a large amount of train delay. Emphasis must therefore be made on the necessity of maintaining the code line in first class condition to avoid breaks and failures. In instances where the code is transmitted over extended distances without drop out stations, such as where the dispatcher is remote from the section controlled, auxiliary lines should be made available. We have gone to the extent of providing standby commercial toll line as protection to insure continuous ctc operation. In another instance, provision is made for transferring the code circuit to a pair of communication wires on a separate pole line.

We have given consideration to arranging the ctc circuits so that they would revert to automatic operation when the code line fails. However, to date we have concluded that the potential benefits to be derived do not justify the expense.

Train Orders Used

By B. J. Alford

Signal Engineer
St. Louis Southwestern
Tyler, Texas

When the code line fails for a long period of time, or emergency requires, the block signal system (ctc) and mechanism for movement of trains and engines by block signals, may be taken out of service temporarily by use of a train order, where territory involved is more than five miles, until repairs can be made.

Trains will be operated by timetable, train orders and rules governing such operation. Block signal system (ctc) and rules governing movement by block signals will be considered suspended during the time specified, and in territory designated. Block signal lights will be extinguished by signal maintainers as soon as possible, after issuance of train order taking signals out of service.

Interlocking rules and interlocking signals are still effective during the time the block signal system is out of service. Trains must approach railroad crossings, drawbridges, junctions, interlockings and the first signal left in service, prepared to stop. Remote control switches must be placed in hand operation. On dual-control switches, the selector lever must be set in "hand" position. Even though block signal rules are suspended, a light burning red, or semaphore arm in horizontal position, unless covered, on a block signal must be respected by train stopping, then proceeding at speed prescribed in train order.

When failure of communication in storms, etc., occurs, and renders it

impracticable to deliver train orders to trains in block signal territory, the superintendent, after specifying speed restrictions, may authorize trains having right or schedule that permits them to proceed, to consider block signal rules suspended between specified block signals, and in such cases all requirements mentioned above, including issuance of train order, will be effective. We normally have train orders issued at terminal points. Where railroad communication fails, we then use commercial telephone service.

ABS Rules Apply

By C. T. MARAK

Signal Engineer
Missouri, Pacific
St. Louis, Mo.

We have operating rules and instructions to cover such conditions when the signal system is interrupted because of a failure, and it is not to be out of service for any length of time. Our operating rules provide under Rule 350 (ABS rules) as follows:

Stop indication per Rule 292—

"When a train or engine is stopped by a Stop indication, and such indication does not change promptly to a more favorable indication:

(1) Communication with train dispatcher or control operator if means of communication available.

(2) Train or engine may proceed at low speed to the next 'Clear', 'Approach-Medium', or 'Approach' signal, upon verbal advice from train dispatcher or control operator in words: 'There is no opposing train in the block.'

(3) Train or engine may proceed only under flag protection to the next 'Clear', 'Approach-Medium', or 'Approach' signal when there is lack of communication, or upon verbal advice from train dispatcher or control operator in words: 'Proceed under flag protection.' These words must be used when train dispatcher or control operator does not know that there is any opposing movement involved.

"The procedure under (1), (2) and (3) must be repeated at each Stop indication. When the signal in advance can be seen to be a 'Clear', 'Approach-Medium', or 'Approach' signal, and track can be seen to be clear to such signal, train or engine may pick up flagman and proceed at low speed to such signal."

Exception to Rule 350:

"Communication with train dispatcher is not required when excepted in Rules 345 and 402, or in making switch movements within yard limits under the provisions of Rule 93 outside territory where Rules 400 to 406 inclusive are in effect.

"Outside territory where Rules 400 to 406 inclusive are effective, written flagging instruction of work extra flagman stationed at a Stop indication will govern in proceeding from such signal, but in no case will train exceed low speed."

When signals are to be taken out of service, operations of trains are governed by Rule 356, as follows:

"Taking signals out of service.—When emergency requires, ABS and mechanism for movement of trains and engines by block signals, may be taken out of service temporarily by use of train order, Form Z, where territory involved is more than 5 mi., until repairs can be made.

"Trains will be operated by timetable, train orders and rules governing movement by block signals will be considered suspended during the time specified and in territory designated.

"Block signal color lights must be extinguished by signal maintainer as soon as possible. Interlocking rules and interlocking signals are still effective. Trains must approach railroad crossings, draw-bridges, junctions, interlockings, and first signal left in service, prepared to stop. Facing-point spring switches must be examined on the ground, by throwing over and back by hand. Remote control switches must be placed in hand operation. On dual-control switches, selector lever must be set in 'Hand' position, switch operated once by hand and left lined for the main track. At other remote control switches, the switch points must be spiked for main-track movement.

"Train order, Form X, must be issued prescribing such speed restriction of passenger trains and freight trains as will insure absolute safety.

"Even though ABS rules are suspended, a light burning Red, or a semaphore arm in horizontal position, unless covered, on a block signal must be respected by train stopping, then proceeding at speed prescribed in Form X order.

"When the failure of communication in storms, etc., renders it impracticable to deliver train order, Form Z, to trains in ABS territory (not including territory where rules governing opposing and following movements by block signals are in effect), the superintendent, after specifying speed restrictions, may authorize trains having right or schedule, that permits them to proceed to consider ABS rules suspended between specified block signals, and in such case all requirements of this rule except issuance of train order, Form Z, will be effective."

The Form Z, train order, referred to in Rule 356 is to be issued as follows:

"Taking Signals Out of Service."

"(1) Effective (Time) (Date) ABS temporarily discontinued from Signal No. at (Station) to Signal No. at (Station) be governed by Rule 356.

"(2) Effective (Time) (Date) ABS and operation by block signals discontinued from Signal No. at (Station) to Signal No. at (Station) be governed by Rule 356.

"(3) Order No. is annulled. ABS restored to service.

"(4) Order No. is annulled, ABS and operation by block signals restored to service.

"Example (1) will be used when discontinuing ABS. Example (2) will be used when discontinuing both ABS and operation by block signals. Example (3) or (4) will be used when restoration is made."

Amplifier Equipment

In freighthouse centralized checking systems using communications consoles for the check clerks, do you locate the amplifier equipment inside the console, or separately rack mounted in equipment cabinets? Please explain reasons for your choice.

Rack Mounted

BY R. B. JOHNSON

Assistant Superintendent
of Communications
Northern Pacific
St. Paul, Minn.

On the Northern Pacific, we have freighthouse centralized checking systems at St. Paul, Minneapolis, Fargo, Billings and Seattle. At each of these locations there are either three or four checker consoles mounted on a long counter-type desk and spaced about 6 ft. apart. Each console contains only the various keys for the lines to the telephone or loudspeaker locations throughout the freighthouse, while the amplifiers and the power supply units for the system are mounted on a separate 19-in. relay rack. There is a transmitting and receiving amplifier for each console, and also an amplifier for incoming calls from the various telephone locations to the checkers office, and an amplifier which is used by all checker positions for paging to main points throughout the freighthouse.

The individual transmitting and receiving amplifiers were designed by our electronics engineer and built in our own shop, and have plug-type connections for the input and output circuits so that an amplifier can easily be disconnected and removed from the rack for inspection and testing when necessary. Enough consoles have been provided at each freighthouse so that there is generally one not in use; therefore, in the event trouble develops in an